THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVII. No. 665.] LONDON, FEBRUARY 8, 1876. [28TH YEAR.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—10,000 cubic feet of gas per ton of coal; 26-candle gas; 13¼ cwt. coke per ton of coal.
The London Exhibition in 1851 was lighted with gas made from Ramsay's Cannel.
RAMSAY'S PATENT CONDENSED COKE.
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GAS-RETORTS, introduced 1828. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.
Manufactories—Derwenthaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne; and London Wharves—Falcon Wharf, No. 86, Bankside; and Honduras Wharf, Cubit Town. Large stocks kept.
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GENUINE TORBAY PAINT
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SPECIAL GASOMETER PAINT
(Mixed ready for use).
These Paints are now used in 100 Country Gas-Works, and by all (but one) of the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.
They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.
The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov. 2, 1866.*
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(SUCCESSORS TO SAMUEL CALLEY. ESTABLISHED 20 YEARS.)
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WORKS: BRIXHAM, TORBAY.

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JOSEPH COWEN and CO.,
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Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS-RETORTS and OTHER OBJECTS in FIRE-CLAY," and they were also awarded at the INTERNATIONAL EXHIBITION of 1862, the PRIZE MEDAL for "GAS-RETORTS, FIRE-BRICKS, &c., for EXCELLENCE of QUALITY."
J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
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Established at the commencement of Gas Lighting.
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J. R. and Co. are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.
J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanized Tubes and High-Pressure Tubes, &c.
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Also, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.
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CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
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RETORT-SETTING A SPECIALITY.
RETORTS SET, AND GUARANTEED TO BURN OFF A CERTAIN AMOUNT OF COAL, OR ELSE NO MONEY TAKEN FOR THE CONTRACT.
PLANS ON APPLICATION.
Retort-Setters sent to all parts of Europe and America.
Address, J. and H. ROBUS,
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WARRANTED TO MEASURE CORRECTLY, AND NOT TO VARY.

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LONDON, 1862. CLASS XXII.
PARIS, 1867. SILVER MEDAL.
AMSTERDAM, 1869.
DIPLOMA D'EXCELLENCE.
VIENNA, 1873. THE ONLY MEDAL.
MANCHESTER, 1875. SILVER MEDAL.

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G. G. & Co. having had their premises entirely rebuilt, are now fairly in possession of large and commodious workshops, specially adapted to the requirements of the trade, and they are prepared to execute orders, large or small, with promptness and despatch.

THEY KEEP IN STOCK METERS OF ALL SIZES, UP TO 300 LIGHTS.

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Mr. A. DEMPSTER, POST-OFFICE PLACE, MELBOURNE.
G. G. & Co. have just been awarded a SILVER MEDAL for Gas-Meters and Gas Apparatus at the Exhibition of the "Society for the Promotion of Scientific Industry," Manchester.

SILVER MEDAL, PARIS EXHIBITION, 1867.

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WROUGHT-IRON TUBES AND FITTINGS

AND

LAP-WELDED IRON AND HOMOGENEOUS METAL BOILER TUBES.

Boiler-Tube Ferrules, Gun-Metal Gland Cocks, Water-Gauges, Whistles, &c.; Stocks, Taps, and Dies for Screwing, and Gas-Fitters Tools.

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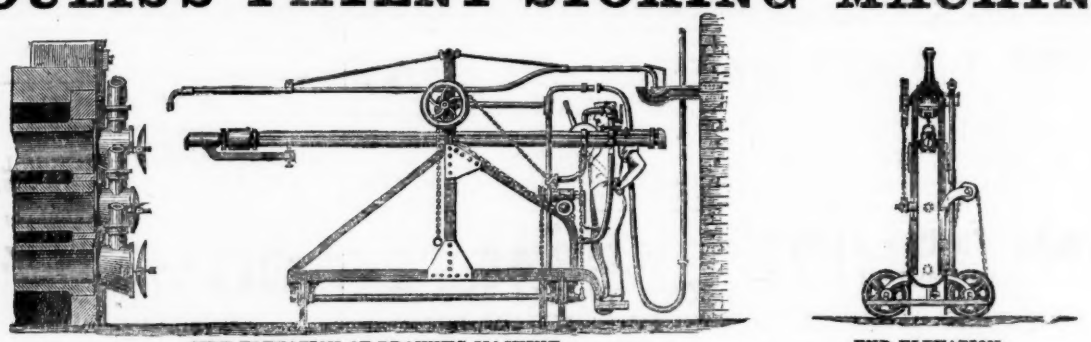
FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF DRAWING MACHINE. END ELEVATION.

(The Charging Machine will be Illustrated in next week's Advertisement.)

Makers: TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester; ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz;
Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

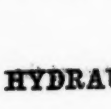
The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

INCREASED VOLUME OF GAS PER TON.—INCREASED YIELD PER RETORT.—INCREASED BULK OF COKE FOR SALE.—REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.

A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to the Consulting Engineer, R. P. SPICE, Esq., M. Inst. C.E., 21, Parliament Street, London, S.W., or to the Engineer and Analyst, F. W. HARTLEY, Esq., A. Inst. C.E., 55, Millbank Street, London, S.W.

TRADE MARK



THE MEDAL FOR 1862.

The only Prize Medal awarded for TUBES & FITTINGS.

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JAMES RUSSELL & SONS, LIMITED,

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MANUFACTURERS OF

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LAP-WELDED, LOCOMOTIVE, MARINE, and other BOILER TUBES;
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PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

SOLE MANUFACTURERS OF LIVESEY'S PATENT GASHOLDER MAN-LID,

By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

ROOFS, GIRDERS, BRIDGES, AND BOILERS OF ALL KINDS.

Drawings, Specifications, and Estimates supplied on application.

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THE

LANCASHIRE GAS-METER COMPANY,

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FALCON STREET, OLDHAM,

MANUFACTURERS OF

GAS-METERS, GOVERNORS, EXPERIMENTAL GASHOLDERS, &c.

HENRY THOMAS, Managing Director.

JOHN WRIGHT AND CO., ESSEX WORKS, BIRMINGHAM,

Beg to call the attention of MANAGERS and DIRECTORS of GAS COMPANIES to the following letter which they have lately received.

COPY OF LETTER RECEIVED FROM MAGNUS OHREN, Esq.

To Messrs. John Wright and Co., Essex Works, Birmingham. *Crystal Palace District Gas Company, Lower Sydenham, S.E.*

Dear Sirs,—In reply to your inquiries, I am glad to state that the use of GAS COOKING AND HEATING STOVES has been a complete success here. We have several hundred in use in our districts. We also find it advantageous to let out Stoves at a small rental. We have now 275 Stoves at rent.

The Stoves you make I can with confidence recommend, having so many in use, and giving satisfaction. I need scarcely point out to you the advantage to Gas Companies to recommend the use of Gas Stoves to their Gas Consumers, even where they do not supply them on sale or rent, as the use of Gas Stoves brings day consumption, and thus the Company make a profit by day as well as by night.—I am, dear sirs, yours faithfully, MAGNUS OHREN.

Size, 25½ in. high; 14 in. wide; 12½ in. back to front.

Price 50s., complete with Pan and Gridiron.

GAS HEATING STOVES

(TERRA COTTA AND IRON).

THE CHEERFUL STOVE.

COOKING STOVES.

BREAKFAST COOKERS.

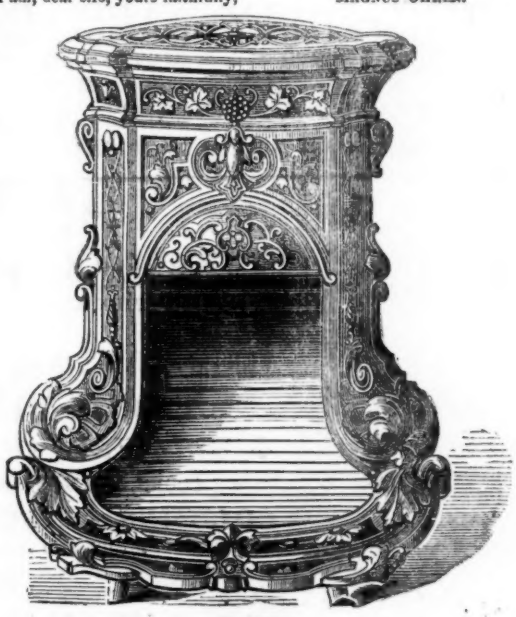
BATHS HEATED by GAS

GAS STOVES

For Boiling, Broiling, Preserving, Heating Flat Irons, and for all other Domestic Purposes.

Gas Companies and the Trade who have not our Illustrated Catalogue are respectfully requested to apply for same.

A LIBERAL DISCOUNT to the TRADE.



No. 4003.

THE CHEERFUL GAS STOVE, with Copper Reflector,

Has all the appearance of a Bright Fire.

PRICE from 32s.

THE

IMPERIAL METER COMPANY,

LIMITED,

KING'S ROAD, LONDON, N.W.,

OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

TO GAS COMPANIES, ENGINEERS, &c.

These Works are in full operation, and it will be the aim of the New Company not only to keep up the excellent workmanship of their predecessors, but, by the introduction of special machinery, to manufacture **Meters of a higher standard than is usually given, without increasing the cost.**

Special attention is invited to the Compensating Wet Gas-Meter of De Castro and Burton, which is now becoming so generally adopted, and is more simple in construction than any other Compensating or Ordinary Wet Meter. There is but one centre of friction to be overcome by the gas. By its self-adjusting principle it maintains an unvarying water-line; and the reservoir contains sufficient water to supply the Meter for twelve months without attention. It is unaffected by "tilting," and cannot be "flooded" by any pressure.

The Company also manufacture Dry Meters upon the most improved principle, and all their Meters being made to standard gauges, the most accurate measurement is obtained.

Attention is also called to their Dry Meters in Wood Cases, as used by some of the London Gas Companies. These Cases are a great preservation to Tin-plate Meters, especially in seaport towns, where the air is impregnated with salt; they are also particularly suited for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

JOSEPH AIRD,

WELLINGTON TUBE-WORKS, TIPTON, STAFFORDSHIRE,

MANUFACTURER OF

EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
CORE BARS, COILS, COCKS (IRON OR BRASS),
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.

THE FARNLEY IRON COMPANY, LIMITED,

FARNLEY, near LEEDS,

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS & FIRE-BRICKS,

Of every size and shape, and of the best quality; also of White and Coloured GLAZED BRICKS, SANITARY PIPES, &c., &c.

The F. I. Co. have the exclusive right to make and sell Fraser's Patent "Ribbed" Gas-Retorts in Fire-Clay.

In order to meet the constantly increasing demand for their Gas-Retorts, the F. I. Co. have recently made such an addition to their premises as will enable them to execute expeditiously the largest home or foreign orders.

Apply as above, or to the London Offices, 15, NEW BROAD STREET, E.C.

HODGE & CO.'S

IMPROVED VENTILATING SUN-LIGHTS

WITH TALC REFLECTORS AND SELF-ACTING VALVES
TO PREVENT DOWN-DRAUGHT;

VENTILATING GLOBE LIGHTS for DINING-ROOMS, LIBRARIES, &c.

Ormolu, Bronze, & Crystal Gaseliers;

MEDIÆVAL CHURCH WORK AND CORONÆ

COCKS, VALVES, and FITTINGS for GAS, STEAM, and WATER;

COLUMNS, BRACKETS, & STREET LANTERNS;

BLACK AND GALVANIZED BARREL COMPO AND TIN PIPE.

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Drawings and Prices upon application.

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THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

MANUFACTURERS OF ALL DESCRIPTIONS OF

FIRE GOODS, and Salt-Glazed Drain-Pipes.

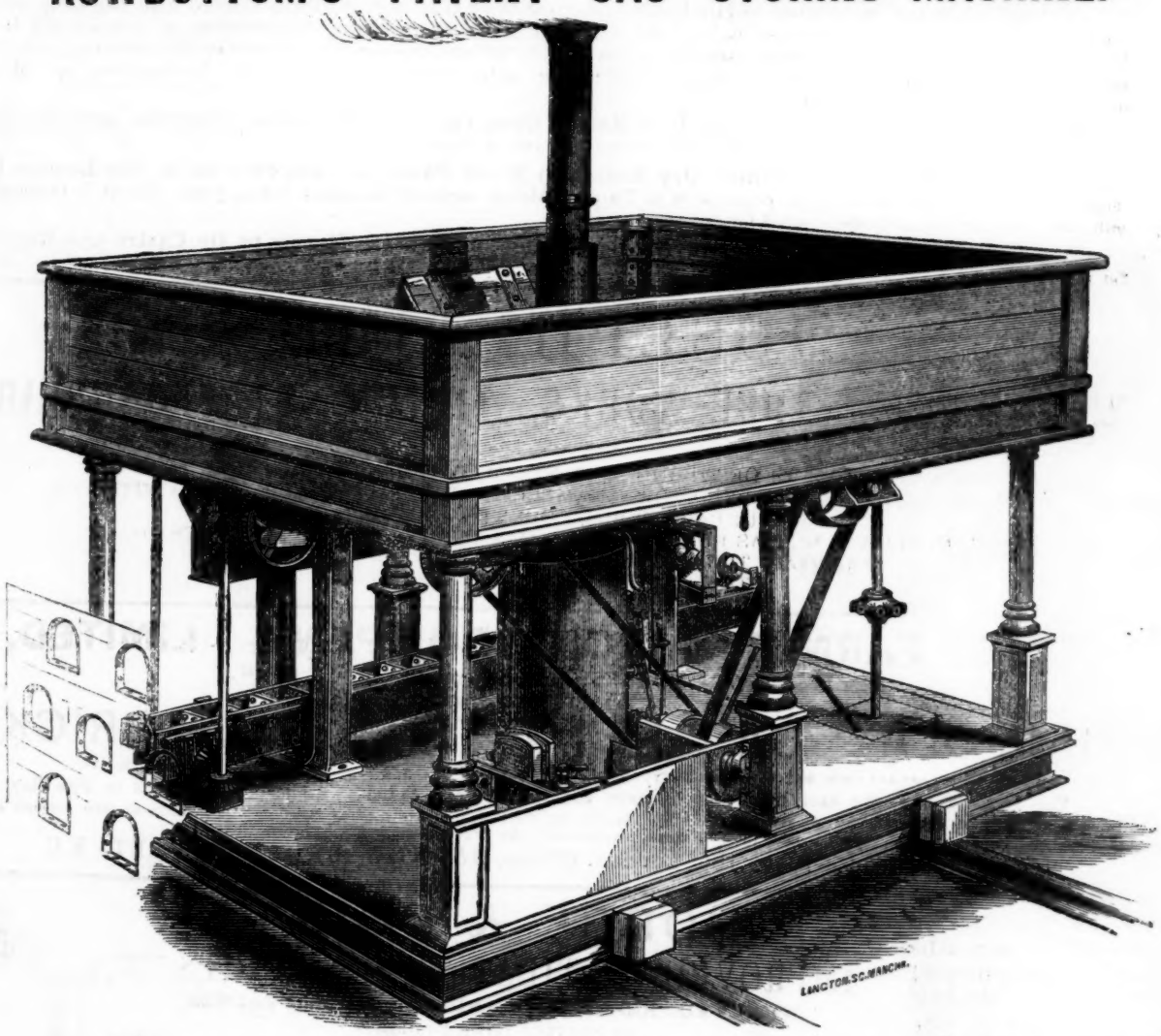
LONDON WHARF:

Wharf No. 4, inside Great Northern Goods Station, King's Cross, N.;

LIVERPOOL—1, Back Leeds Street,

Where is always kept a Stock of Retorts, Fire-Bricks, Terra Cotta Ware, and Drain-Pipes.

ROWBOTTOM'S PATENT GAS STOKING-MACHINE.



By the adoption of this Machine, a saving of at least 50 per cent. in labour will be secured. A great saving of time is effected, as the pro-mover, which enters one end of the retort, discharges the coke at the other end, and on the return charges it with coal, thus increasing the effectiveness of the retort. The first cost, and the cost of working it, will be far less than that of any other Stoking-Machine.

J. ROWBOTTOM,

GAS ENGINEER,

2, CRIPPLEGATE, HALIFAX.

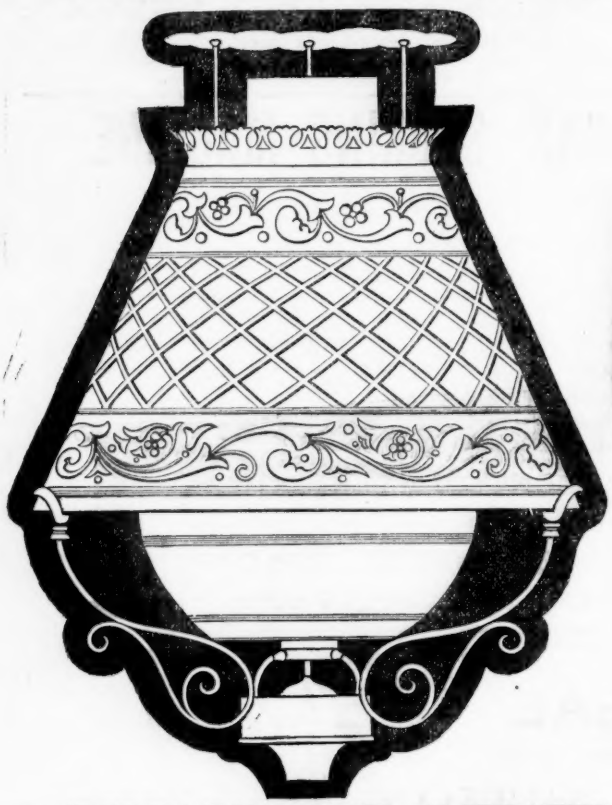
WILLIAM SUGG,

GAS ENGINEER,

VINCENT WORKS, VINCENT STREET,

WESTMINSTER, S.W.

WILLIAM SUGG'S LATEST IMPROVEMENTS IN GAS-BURNERS.



The "LONDON" ARGAND BURNER, with SELF-ACTING GOVERNOR (Patent).

"Westminster" Pattern Shade, as used in the Ministers Rooms and Lobbies of the Houses of Parliament. This Burner is No. D size, and, with a consumption of 5 cubic feet per hour, gives about 2 candles more light than the Gas Referees model, called the No. 1 "London" Argand Burner.

With 5 cubic feet per hour of gas, which gives a light equal to 14·3 parliamentary sperm candles (as tested by the Sugg-Letheby Standard Burner), the ordinary Argands give only a light equal to 10 sperm candles, while the No. F Patent "London" Argand Burner gives a light equal to 18½ sperm candles, or 85 per cent. more light for the same quantity of gas consumed.

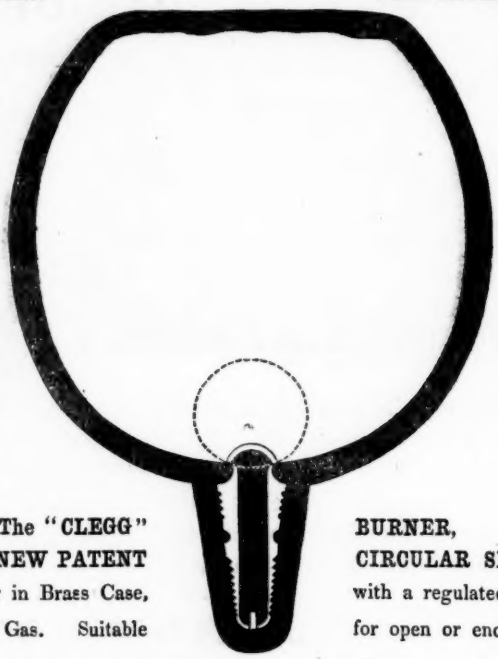
The "CHRISTIANIA" FLAT-FLAME BURNER, with SELF-ACTING GOVERNOR (Patent).

This Burner has been pronounced by the most eminent Engineers of the day to be the perfection of a flat-flame Burner.

The Shades, which are made in a beautiful white glass called Albatrine, are manufactured *exclusively* for these Burners, and cannot be obtained elsewhere.

The light emitted from this Burner is very white and soft to the eyes, and is about 30 PER CENT. superior to the ordinary fishtail.

Numerous other pattern Shades, Plain or Ornamental, may be obtained with these Burners.



The "CLEGG" with the NEW PATENT Is a flat-flame Burner in Brass Case, admission of Gas. Suitable

BURNER, CIRCULAR SLIT, with a regulated opening for the for open or enclosed Lights.

Price Lists and Prospectuses, with description of all the "London" Argand and other Burners, and their proper Shades, Supports, &c., forwarded post free on application.

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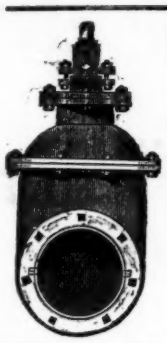
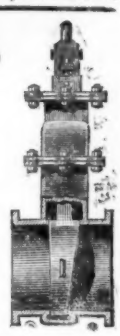
GAS ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS,
AND FOR THE
SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,
AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

THOMAS CARR & SON,
MANUFACTURERS OF
FIRE-BRICKS, LUMPS, TILES, RETORTS,
&c., &c.,
SCOTSWOOD FIRE-BRICK WORKS,
SCOTSWOOD-ON-TYNE.

THOMAS LAMBERT & SONS
MANUFACTURE EVERY DESCRIPTION OF
GAS AND WATER FITTINGS;
ALSO,
WROUGHT-IRON TUBES & FITTINGS.
SHORT STREET, LAMBETH, LONDON.



C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

MIDLAND IRON-WORKS,
DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

LIVESEY FIRE-CLAY WORKS.

NEAR BLACKBURN, LANCASHIRE.
(ESTABLISHED 1835.)

ORLANDO BROTHERS, LIMITED,

MANUFACTURERS OF PATENT CLAY RETORTS,
AND EVERY DESCRIPTION OF
TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.
FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS

THE
PATENT "UNIVERSAL" STEAM PUMP
WAS AWARDED, AT THE
VIENNA EXHIBITION, 1873,
THE GRAND PRIZE "MEDAL OF PROGRESS."
AT LILLE—GOLD MEDAL - - - - 1874. AT MANCHESTER—SILVER MEDAL - 1874.

OPINIONS OF THE PRESS.

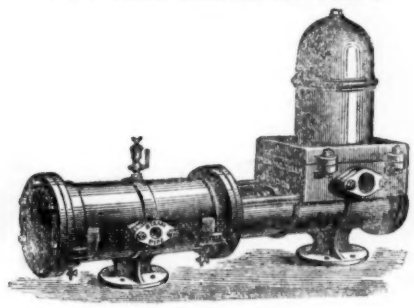
"The simplest machine of its kind."—*Engineering.*

"Remarkable for its simplicity and ease of action."—*Daily Telegraph.*

"None that we have noticed work so quietly."—*The Engineer.*

"Nothing invented in hydraulic steam power half so cheap and effectual."—*Griffith's Iron Trade Exchange.*

NO TAPPET VALVES OR GEAR.



IN USE IN SOME OF
THE PRINCIPAL GAS-WORKS IN LONDON, SHEFFIELD, PENISTONE, &c.,
FOR
TAR AND AMMONIACAL LIQUORS.

ONE SELECTED FROM AMONGST MANY TESTIMONIALS RECEIVED BY H. T. & CO.:—

"*Ardwick Bridge Chemical Works, Manchester, Oct.* 28, 1872.

"Sir,—The 'Universal' Steam Pump obtained from you, and which has been employed during the last six months pumping caustic soda at these works, still continues working satisfactorily,

"Yours truly,
(Signed) "PETER HART, *Manager.*"

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, FEBRUARY 8, 1876.

Circular to Gas Companies.

The fog is clearing away. We fancy we can now discern the beginning of the end of the metropolitan gas agitation. It will be seen by our report of the extraordinary special meeting of the Chartered Company, which will be found in another column, that the Board of Trade have once more put out some suggestions for a settlement of the question; and perhaps we shall not be far wrong, if we mention a probability, that the principles set forth in these suggestions will form the basis of a Bill, which will be submitted by Government to Parliament.

We have before remarked, that if the Government adopted or promoted a measure, distinctly hostile to the interests of gas shareholders, the Bill must be opposed at all risks, and we believe it might be contested with success. The question we have now to discuss is, whether, or not, the most recent proposal of the Government, if carried out, be to the interest of gas proprietors. It may be gathered, that the worst feature of the Regulations Bill—the sliding scale of dividend—will be retained in the new measure; but respecting that we shall say nothing to-day. The point in dispute now is, the mode in which new capital is to be raised. We have somewhat emphatically condemned the first ill-considered scheme of the Chartered Company, to raise all further capital by borrowing. We pointed out, that if the extensive amalgamations, now under consideration, are completed, the day must arrive when the borrowed would exceed the share capital; and, in view of the troublous times which we believe must come again, any loss of profit would fall on the shareholders. Now, a large proportion of gas shareholders are not in a position to lend the money, by which they might, to a certain extent, protect their interests; and, therefore, we are driven to the conclusion, that the original proposal of the Chartered Company was distinctly inimical to the interests of small and middle-class proprietors. The consequence we mention was clearly perceived and remarked upon by a shareholder at the meeting, who takes much interest in the conduct of the company's affairs. But we need not consider this part of the question further, for the directors had resolved to abandon so much of their project, and had decided to fall back on the half-and-half proposal embodied in the Commercial Company's Act of last year. It argues bad generalship, or confessed weakness, to retreat from a position deliberately taken up; but we may express an opinion, that the directors of the Chartered Company did well in giving up their design to acquire unlimited borrowing powers. We are not in love with the provisions of the Commercial Company's Act, but we consider them greatly preferable to those originally put forward by the Chartered Company.

In turn, however, this proposition will have to be reconsidered, side by side with the latest suggestion of the Board of Trade, and the directors will have to make up their minds which they will stand by. Curiously enough, the suggestion of the Board of Trade includes a proposal similar to that we put forward last week—viz., that the companies shall raise all further capital by the issue of new shares, which shares shall be sold by auction to the highest bidder, the premiums realized being capital not entitled to dividend. We have to consider how far this will be advantageous, or not, to the shareholders, whose interests we have to defend. Gas shares now sell in the market for prices which yield the purchasers but little over five per cent. for their money. Here we have an indication of the premiums newly issued shares will be likely to realize. Since, then, the price for which the shares may be sold will only produce five per cent. for the buyer, it may be asked, Why not issue shares at five per cent.? The answer the local authorities will make is that there will then be no check on extravagant issues of capital. As the proposal of the Board of Trade stands, any fresh creation of share capital will involve the creation of capital not entitled to dividend, which is a gain for the public. The broad result is, to place an original shareholder in the position of one who buys his shares in the market. It would be a nice point to determine, if it were possible, how much of the premium, now paid for gas shares, is calculated upon the probability of participating in the advantage of new issues of capital. We have a strong suspicion that no idea of gaining an advantage on this score ever enters the minds of purchasers; but we may be wrong. The fact, we believe, is, that people are content with between five and six per cent. on first-class security, and hence gas shares command their present prices. To this complexion, then, we come at last, that all who wish to possess gas shares must be content with from five to six per cent. interest on their money. That is what the auction clauses mean.

Swallowing our resentment at the infraction of the provisions of the Companies Clauses Act, involved in the proposal, we are strongly disposed to recommend its acceptance by the companies, without hesitation. No confiscation is suggested, beyond that of the "unearned increment," as we said last week. It will leave original proprietors, so far as the shares they already possess are concerned, in exactly the same position; and, as regards new investments, they will simply be required to go into the open market, like other investors. Legally, we believe them to be wronged, inasmuch as they have taken their shares, subject to all the privileges which existing legislation gives to them; but, considering the matter from a strictly moral point of view, we cannot affirm that any injustice would be done by the adoption of the auction clauses. To our minds, then, we have, in this suggestion of the Board of Trade—or, perhaps, we might say, if the truth must be told, the suggestion of the Corporation of the City of London—a solution of the difficulty, as regards the mode of raising new capital. The Bills of the Imperial and South Metropolitan Companies would have had to encounter much opposition, and the end, probably, would have been a defeat. The Commercial Act may be said to have been passed by a fluke. Everybody was sick of gas matters last session. Any Bill, which professed to adopt the suggestions of the Select Committee, was certain to pass. The Bill promoted by the Chartered Company this year has turned out a *fiasco*, and their latest proposal is little better. We advocate share capital, with all its attendant risks and privileges.

There is one point to which, at present, no allusion has been made, but on which we must make a few remarks. Accepting auction clauses, what is the rate of dividend to which the nominal share capital is to be entitled? The higher the rate of dividend allowed, the higher, of course, will be the premiums realized. We fully expect, then, that ten per cent. will be permitted, and thus the premiums will amount to nearly the same sum as the capital entitled to dividend. We may regard this as a great gain to the public, while it leaves the owners of original shares in full and undisputed possession of their rights.

There is still another point. Auction clauses have hitherto been tried only in the cases of comparatively small undertakings. Nottingham is the most considerable town in which they have been adopted. In every case, however, as our columns have borne witness, they have proved a success. The competition for shares has been keen. But supposing the amalgamation, now proposed, to receive the sanction of the authorities, new capital, to the extent of half a million or more, will every now and then

be thrown upon the market, by one company alone. Perhaps we shall not be far wrong when we say that, in the course of the next twelve months, three quarters of a million will be required for gas purposes in the Metropolis. Will the investing public understand the matter, and come forward in the competition, or will the shares be knocked down to large speculators, at premiums less than might have been expected. Experience alone can decide this question, and we only allude to it to point out that, the premiums realized on the sale of shares, on the unprecedented scale which will obtain, if the suggestion we notice be carried out, cannot be expected to be so large as those realized in a comparatively small country town.

We shall soon know what the directors of the Chartered Company think of auction clauses, and may defer any further consideration of them. For our own parts, we are disposed to congratulate the Government on having fallen in with the suggestion of the Corporation of London; and if the two local authorities would only drop the sliding scale, and agree to amendments of the Metropolis Gas Act, 1860, they might produce a measure which would be satisfactory to all parties who do not wish for more than a ten per cent., or rather a maximum, dividend.

We may assume that letters similar to that despatched to the Chartered Company have been addressed to all the Metropolitan Gas Companies, and shall soon expect some general expression of opinion on the question raised; and here we may leave the matter, for the present.

The Town Council of Ipswich are hankering after the gas undertaking. They can make no complaints, for it is admirably managed by Mr. Goddard, who, by the way, is a prominent member of the Council. But the Corporation are smitten with a prevalent disease, and exhibit a morbid longing for something, which may, or may not, prove of value to them. They have consulted a leading London gas engineer, who, as a rule, advocates the purchase of gas companies by municipalities, and we gather, from a local print, that he has reported that the company might be bought for from twenty-two and a half to twenty-five years purchase of maximum dividends. If this latter price be acceded to, we do not think that any one would have reason to complain. The undertaking would only cost the Corporation about one hundred and twenty thousand pounds, and as Ipswich is a growing town, we have no doubt the transfer would be advantageous to the Council. Let the gas consuming ratepayers, however, accept our advice, and, if the transfer take place, see that they pay for gas, and nothing else.

We have already mentioned that the Local Board of Burslem had come to an agreement with the gas company for the purchase of their undertaking. They have since applied to the Local Government Board, for permission to borrow money to complete the purchase, and, as a report in another column shows, the Central Authority have sent down an inspector to make inquiries. It was Mr. Lowe, we rather think, who suggested that the inspectors would soon equal in number the inspected. The idea is rather extravagant; but it must, we fear, be admitted, that every year adds to the number of the Inspectors. What we call the *local* government of the country is gradually becoming more and more under the control of briefless barristers, patientless doctors, and military officers, who, we may presume, having recognized their incapacity to get on in the profession they originally chose, have availed themselves of the interest they possess to obtain Government employment in another shape. We have nothing to say against Major Tulloch. We know nothing of him, except that he is an Inspector under the Local Government Board, and we have not an Army List by us to refer to, in order to see what distinguished services he has performed as an Engineer officer. As an Inspector, he is sent to make special inquiries, and is in nowise called upon to express his opinion on general questions. He is perfectly welcome to hold the private opinion, that all "gas, sewer-"age, and water supply" should be in the hands of the local authority; but, as a Government Inspector, he would do well to imitate his superiors, and keep the opinion to himself. Nor is he at all justified in making the sneering observation, that the object of private companies was to make good dividends, whereas local authorities were actuated by the double desire to supply a good article, and keep down the rates. We have our own views on this matter, but may pass on. The distinguished Engineer officer seems to have been astonished at the fact that the Public Loans Commissioners should have demanded five per cent. for money lent to purchase gas-works. We think the Commissioners terms perfectly justifiable. When they lend money for unproductive—as, for example, sewerage—works, they may very properly do so at the lowest possible rate of interest. But when the money is to be advanced for productive—as, for example, gas—works, the Commissioners are perfectly justified in exacting as high a rate of interest as would be required by an Insurance Office or the Bank of England.

After these remarks, we may mention that the price agreed upon for the purchase of the Burslem and Tunstall undertaking is a very fair one, being very nearly twenty-three years purchase of last year's profits. Major Tulloch announced his intention to examine the works before he reported. What knowledge he has of gas-works, we do not know; but we have good reason to believe that he will find the Burslem works in excellent condition, and the undertaking well worth the purchase-money. A word to the ratepaying gas consumers in the district:—Take care that you are charged for nothing but gas in your bills!

Vice-Chancellor Bacon has given his decision in the case of *Patterson v. The Chartered Company*. As an appeal may be lodged, it is doubtful whether the case is as yet a proper one for discussion in a public Journal, matters still *sub judice* being considered not open to public discussion. We feel bound to say, however, that the Chartered Company can hardly be inconvenienced by the decision. We, who have good reason to remember, although we have not now the exact figures before us, know that ten or twelve years ago Mr. Harris, at the Bow Common Works, kept the "sulphur" impurity well down under the parliamentary standard. The Chartered Company, then, have only to revert to the original practice of Mr. Harris. We gather from the evidence that the process of purification he follows now, is exactly that he practised many years ago, and if so, the company have fair grounds for an appeal. A question arises, but which we shall not now discuss, whether lime can possibly be used for the removal of "sulphur," using the word in the late Referees sense, without infringing or paying for Mr. Patterson's patent. The question will presently arise, How are the damages to be assessed? It cannot be contended that the company have made any profit by the use of the alleged invention. All that can be urged is, that they have saved a daily fine for excess of "sulphur," it being, when the patent was taken out, in the power of the Patentee to fix the maximum allowable. Profit in the ordinary sense of the word, the company have certainly not made from the use of what is called the Patentee's invention. The Chartered Company's gas has been worth neither more nor less in consequence of its freedom from sulphur. The assessment of damages will, therefore, involve a curious dispute. We shall not further allude to the matter, until the company have decided not to make an appeal, or the question has been finally decided.

Mr. G. Livesey has been fortunate enough to get a letter inserted in the *Times*, explaining his views on the sulphur question. We are glad to see public attention called to the matter, in that popular journal, for it reaches people whom we cannot possibly influence. The writer quotes the statement made in our last—viz., that, applying the severest test, we could find no proof of the presence of sulphurous acid in the atmosphere of a small room, with over thirty gaslights (mostly Argand) burning. This is simply a proof that the quantity of sulphurous acid present is exceedingly minute. The fact, which Mr. Livesey overlooks, is, that the effects of this acid are *cumulative*. It is quickly converted into sulphuric acid, and deposited somewhere, and on something; and no one who has read the evidence of Mr. Medwin, and the late Mr. Clift, of Redditch, or who has examined the bindings of books taken from the top shelves of the libraries of the Athenæum Club and the College of Surgeons—no one who knows the consequences of the use of gas in silversmiths and cutlers shops, or has had, as we have had, the opportunity of examining the condition of printed calicoes kept for a long time on the top shelves of a country draper's shop, supplied with gas containing upwards of forty grains of sulphur per hundred feet—can doubt for one moment that "sulphur" produces mischievous effects. While, then, combating the exaggerated notions put forth on the subject, we have always urged the desirability of removing as much of the "sulphur" as possible, and we adhere to the opinion, that this can be done without much trouble, and without producing a nuisance. We agree with Mr. Livesey in the belief that Corporations possessing gas-works do not trouble themselves about the matter; and in the case of Burslem, mentioned above, where an awful row has been made about "sulphur," we may expect to hear no more about it, when the gas undertaking gets into the hands of the Local Board. We may mention that the Corporation of Manchester do exert themselves to keep down "sulphur," which, if we remember rightly the reports of their able examiner, Mr. Leigh, does not often exceed ten or eleven grains per hundred feet of gas.

We are glad to see that the Dundee Gas Commissioners are about to take into consideration the advisability of reducing the illuminating power of their gas. For our own parts, we feel certain that twenty-candle would give more satisfaction than thirty-candle gas.

Our space is exhausted, and we must sum up, very briefly, our other items of intelligence. The Town Council of Margate are deliberating as to whether, or not, they shall assist the Ramsgate Local Board, in their endeavour to acquire the Ramsgate works

of the Isle of Thanet Gas Company. The Local Board of Ely have carried a resolution to set up competing gas-works. They have reckoned without their host. They must first consult the occupants of Gwydir House, who will set them right as to their powers. The Local Board of Sevenoaks and the gas company have agreed to split the difference, as we suggested last week; and a majority of the Board decided to withdraw from further opposition to the company's Bill. The minority have, however, demanded a poll of the ratepayers on the question. The Aston Local Board have come to terms (not yet made public) with the Corporation of Birmingham, for the purchase of that part of the gas undertaking of the Corporation, lying within their district.

Our readers will see, by a report in another column, that the judgment given in favour of the Alliance Company, in the case of Mr. Taafe, has been reversed by Chief Justice Morris. We regard the evidence given for the appellant, as eminently unsatisfactory. It was not made (according to the report before us) at all clear, as to when the gas was shut off from the meter, or when it was turned on again. If the evidence of the two servant girls be accepted—and we do not see why it should not have equal weight with that of the junior Mr. Taafe—it is quite clear, that there was ample time for the consumption of two thousand feet of gas between the times of taking the meter. The accuracy of the meter was certified by Mr. Sporne, the well-known examiner of the Commissioners of Sewers of the City of London. Meters will not move of their own accord, and we cannot help thinking, that, by the decision of Chief Justice Morris, a great injustice has been done to the Alliance Gas Company.

Water and Sanitary Notes.

The Corporation of the City of London, by the instrumentality of the Commissioners of Sewers, have set to earnest work, under the Artizans Dwellings Act. They have elaborated one scheme for the abolition of a "fever den"—not that we remember to have heard that fever is particularly prevalent there—known as Holiday Yard, and lying under the shadow of St. Paul's, and we have no doubt it will soon receive the sanction of the Home Secretary. Several other schemes, for improvements in other districts in the City, are now under consideration, and there is every prospect that the provisions of what must prove a very valuable Act, will be effectually administered in the City. We have remarked, more than once, that when the Corporation of London make up their minds to do a thing, they invariably do it well, and we expect the happiest results from the action they are taking under the Act we have mentioned.

Here we may be excused for stopping a moment to congratulate the Commissioners of Sewers on their selection of a chairman. Mr. F. Cox and we, are at hopeless variance on the gas and water questions which are now agitated; but we feel bound to acknowledge his great qualifications for the post he has been selected to fill. A shrewd, hard-headed man, with a very large amount of information respecting matters with which he will have to deal, much experience in the administration of local affairs, and a tolerably fluent speaker, he is just the man for the office. Possibly he lacks the urbanity which characterized his predecessor; but that is merely a constitutional defect, and a matter of no moment.

The Metropolitan Water Companies, we are given to understand, have declined to confer with our two local authorities in Guildhall. We are not at all surprised at this. It is usual for diplomacy to precede a declaration of hostilities. In this case an attempt has been made to reverse the ordinary mode of procedure, and the water companies naturally feel somewhat indignant. We are satisfied that nothing will be settled in this year's session with regard to the metropolitan water supply. Some abstract resolutions, meaning little, and not committing anybody to anything, will probably be carried in both Houses of Parliament. But, *cui bono?* We wait for a Municipality. Who will give it to us?

The Water Committee of the Corporation of Liverpool deliberated for hours, one day last week, and decided on nothing. Why do not the committee take our advice, and try the experiment of sinking new wells—it is their only safe course—and, once and for all, determine whether, or not, a local supply, sufficient for their wants, can be obtained? If it can be, they must develop the scheme; if not, they will be fully justified and supported in adopting one of the expensive schemes now before them, for bringing water from a long distance.

A report, characterized by his usual ability and fairness, has been presented by Major Haywood to the City Commissioners of Sewers, on the Liernur system for the disposal of sewage. On this, and on the letter of Captain Liernur, which appeared in the *Standard* last week, we intended to make some lengthy remarks, but space fails us this week. We must note, however, that both the inventor and the reporter agree with us, that the adoption of the system is out of the question in towns now completely sewered. It deserves, however, as Major Haywood states, a trial, in limited districts, of towns not completely sewered, such as Birmingham and Edinburgh. The objection is the cost of installation, which is rather large, but we fully coincide in the opinion that the system deserves a fair trial. The Chancellor of the Exchequer probably will not have a surplus to dispose of in his next Budget; but, if he had, we should certainly fall in with Mr. Greg's suggestion, and advocate the appropriation of a portion of it to some experiments with the Liernur system. It is the only plan before us to-day, which professes to secure the full value of human excreta. The question is of the last importance to the agricultural future of this country. The vast population of China live, we may say, on themselves. We exist, to a great extent, on imported manures, and when they fail us, as they certainly will, at no distant time, England must become depopulated, if steps be not taken to return the food consumed to the soil of the country.

THE WATER BILLS FOR 1876.

The space at our command obliges us to keep the notices of these Bills within the narrowest limits. We shall not, in any case, attempt any description of the works it is proposed to construct; but the character of the water it is proposed to supply will be indicated, when we have a knowledge of its source. The water-rates will only be mentioned when they present some unusual feature.

The following Bills are to incorporate companies already in existence, or entirely new, with the usual statutory powers:—

The *Braceborough Water Bill* is to incorporate a new company, for the supply of a district lying between Braceborough and Paston, in the counties of Lincoln and Northampton. The capital proposed is £64,000, in £10 shares; and borrowing power, to the extent of one-fourth of the capital raised, is sought. The supply is to be constant, and the rates, proposed to be paid in advance, are those usually fixed.

The *Littlehampton Water Bill* is to incorporate a new company, for the supply of Littlehampton and other places in Sussex. The capital proposed is £10,000, in shares of £5 each, with the usual borrowing power. The novel feature of this Bill is, that it proposes to give the Local Board of Littlehampton power to join in the undertaking, and, for that purpose, to borrow £2500. The source of the water is to be a well in the chalk.

The *North-East Worcestershire Water Bill* is to incorporate a company, for the supply of Droitwich, Bromsgrove, and Redditch, and several other places, in the counties of Worcester, Stafford, and Warwick. The capital proposed is £78,000, in £10 shares, which shares may be divided into preferred and deferred half shares. The usual borrowing powers are sought. Ordinary rates, and the usual extra charges, may be levied. The source of the water will be two wells in the parish of Bell Broughton.

The *Rosstrevor Improvement Bill* is to incorporate a company with many duties and privileges, one of which will be the supply of water to Rosstrevor, in the County Down, Ireland. The capital proposed is £30,000, in shares of £10 each, and power is sought to borrow £10,000. The works proposed include an embankment for a promenade, the construction of a pier, and also of a tramway. Ordinary rates for a domestic supply of water may be charged, but the extras are rather higher than usual. The water, it would appear, is to be taken from Carlingford Lough.

The *South Hants Water Bill* is to incorporate a company for the supply of Romsey and other adjacent places in the county, but not within the limits, of the Municipal Borough of Southampton. The capital proposed is £50,000, to be raised in shares of £10 each. Power is sought to divide these shares into preferred and deferred half-shares. The usual borrowing power is prayed. Usual rates are proposed. The source of the water is to be a well in the parish of Timsbury.

The *Uppingham Water Bill* is to incorporate a company for the supply of Uppingham, in the county of Lincoln. The capital proposed is £6000, carrying the usual borrowing power. The source of the water is to be a well in the parish of Lyddington.

The *West Brighton Water Bill* is to incorporate the West Brighton Water-Works Company, Limited, with power to supply fresh and sea water to the district of Hove. The original capital of the company is called £45,000, and power is sought by the Bill to raise £5000 additional, the dividend on which is to be limited to seven per cent. or six per cent., as usual. Power is sought to borrow £12,000 in respect of capital already paid up. Shares, if the shareholders so decide, may be divided into preferred and deferred half-shares. The source of the fresh water is some springs and wells in the parish of Preston. No special arrange-

ments are proposed for the distribution of sea water. The domestic rate proposed for a supply of fresh water is ninepence on the rateable value, according to the poor-rate assessment, with, apparently, no extra charges.

All the above Bills seek the powers and privileges usually conferred on water companies, and no one offers any remarkable features, other than are noticed above.

The following Bills are to confer further powers on companies already incorporated by statute:—

The *Bridgewater Water Bill* is to extend the time granted to the Bridgewater Water-Works Company, by their Act of 1871, for the completion of works. Power is also sought to raise additional share capital to the amount of £6000, and to borrow to the usual extent in respect of it. A long scale of domestic rates is proposed, commencing with 8s. 8d., when the annual rack-rent does not exceed £5, and ending with £5 10s. when the annual rack-rent exceeds £100.

The Bill of the *Chesterfield Water-Works and Gaslight Company* is to enable the company to raise additional capital to the amount of £126,000, carrying the usual borrowing power, in order to extend their water and gas undertakings. This Bill should have been noticed last week.

The *Cleveland Water-Works Bill* is to extend the limits of the Cleveland Water Company, and to authorize them to raise additional capital to the amount of £120,000, carrying the usual borrowing power. In this Bill, we find a definition of the term "annual value," which may be worth quotation. "The term "annual value," says the 15th section, "shall mean the annual "rent which a tenant, taking one year with another, might "be reasonably expected to pay for the dwelling-house supplied "with water, if he undertook to pay all tenants rates and taxes, "and if the landlord undertook to bear the cost of the repairs "and insurance, and any other expenses necessary to maintain "the premises in a state to command the said rent;" provided, however, that where a separate charge is made for water for a garden attached, the estimated value of such garden is to be deducted.

The *Newcastle and Gateshead Water Bill* is to authorize the Newcastle and Gateshead Water-Works Company to raise £360,000 additional capital, and to borrow to the usual extent in respect of it. The Bill is further to authorize extensive additions to the works of the company, and the laying of a system of mains for the supply of water for trade and manufacturing purposes, separate from the pipes distributing water for domestic use.

The Bill of the *City of Norwich Water-Works Company* is to extend their limits of supply, and enable them to raise additional capital to the amount of £80,000, carrying the usual borrowing power.

The *Plymouth Dock (Devonport) Water Works Bill* is to authorize the company of proprietors of the Plymouth Dock Water-Works, first of all to make stringent regulations for the prevention of waste, &c., and then to charge a domestic rate of six per cent. on annual value. Power is also sought to raise £40,000 additional capital, the dividends on which are limited as usual to six per cent. or seven per cent. The company have at present no mortgage debt. Hence power is applied for to borrow £20,000 in respect of the original, and to the usual extent in respect of the new capital.

The *Ramsgate Water Bill* is promoted by the Ramsgate Water-Works Company, who, under the authority of an Act passed in the fifth year of King William IV., have raised and expended share capital to the amount of £15,000, and who have also expended out of profits the sum of £19,000. The Bill proposes to capitalize the latter sum under the name of "Improvement Stock," to be allotted rateably as usual. It is further desired to raise £15,000 additional capital, which is to carry the ordinary borrowing power. In respect of the Improvement Stock, power is sought to borrow £4750.

The *Shepton Mallet Water-Works Bill* is to authorize the company to raise £2800 additional capital, and to borrow £700 in respect thereof, for the construction of new works. We should have thought a Provisional Order would have answered the purpose of this small company.

The *Southwark and Vauxhall Water Bill* is to enable the company to take over the Richmond Water-Works Company, for and on behalf of whom the Southwark and Vauxhall Company have, since 1861, supplied water to the parish of Richmond. The Bill also proposes a considerable extension of the limits of the company. As the measure is certain to be strongly opposed, we need not further allude to its provisions, which possess no remarkable feature.

The *Stockton and Middlesbrough Water-Works Bill* is primarily to authorize the Stockton and Middlesbrough Water-Works Company to construct new works for the abstraction of a further quantity of water from the river Tees. It further proposes to convert the present share capital of the company, £305,140, into stock, with a dividend limited to five per cent. The company further desire to raise £300,000 additional capital, carrying the usual borrowing power. The dividends on the new capital are limited to seven per cent. or six per cent., according as it is issued as preference or ordinary shares, or stock.

The *Wakefield Water-Works Bill* is, first of all, to extend the limits of the Wakefield Water Company, and authorize the construction of additional works. The new source of water proposed would appear to be a well, or wells, in the parish of Darfield. The company desire to raise additional share capital, to the amount of £80,000, carrying the usual borrowing power. Further than this, the company only desire power to make necessary regulations for the prevention of waste, &c.

The Bill of the *York New Water-Works Company* is, primarily, to authorize the company to construct additional works, for the abstraction of a further quantity of water from the river Ouse. For this purpose, the company propose to raise £60,000 additional capital, the dividends on which are to be limited as usual. The usual borrowing power, in respect of the new capital, is prayed. A scale of charges for water supplied by meter, for trade purposes, is proposed, in accordance with which the charge will vary from 1s. 6d. to 6d. per 1000 gallons, according to the quantity used. Beyond this, the Bill only asks for some ordinary powers.

CHRISTMAS APPEAL.—We have received, since our last, the following:—

Mr. J. C. Ashton	£0 5 0
W.	0 5 0

Making a total of £57 2s.

GAS LIGHTING AT APPLEDORE, DEVON.—A West of England paper states that this town was lighted with gas for the first time on Saturday, the 15th ult.

BRITISH GASLIGHT COMPANY, LIMITED.—An extraordinary general meeting of shareholders was held at the offices, George Yard, Lombard Street, London, on Wednesday last, when a bill in Parliament, empowering the undertaking to enlarge their works and expend further capital at Kingston-upon-Hull, was approved.

FIRE AT THE SHEFFIELD GAS-WORKS.—It is reported that an extensive fire raged throughout Friday last at the Neepsend Gas-Works, where several hundred tons of coke ignited. Four engines poured a vast volume of water upon the burning mass for six hours, and at seven o'clock the fire was subdued. Grave apprehensions were felt by the company as to the result of the fire, as it broke out close to a large holder containing one million cubic feet of gas, and a number of workmen were employed to remove the burning coke from the vicinity.

SOUTHWARK AND VAUXHALL WATER COMPANY.—A special general meeting of shareholders was held on Thursday last to sanction the bill proposed by the directors for vesting in the Southwark and Vauxhall Water Company the undertaking of the Richmond Water-Works Company, for extending the limits of supply of the Southwark and Vauxhall Water Company, for empowering that company to make additional water-works. The chairman stated that the directors were not desirous to proceed with the bill unless it became absolutely necessary. In reply to inquiries, he further stated that the Richmond Vestry were taking steps to initiate water-works of their own for that parish, and that this company had commenced proceedings in Chancery to restrain them. The bill was sanctioned by the proprietors.

HULL WATER SUPPLY.—The *Eastern Counties Herald* states that an official trial of the new engine at the Springhead Water-Works was made on the 26th ult., in the presence of the chairman and committee of the Corporation Water-Works, and Mr. Maxwell, resident engineer. The engine is a noble piece of engineering work, 250-horse power; cylinder, 90 inches in diameter, with 11 feet stroke. It is constructed on the Cornish principle—that is, single acting; the valves worked by tappets, and regulated by cataracts. The beam is a massive piece of wrought-iron work, nearly 40 tons in weight. Below the outer end of the beam is the shaft, 22 feet in diameter and 73 feet deep. Midway down the shaft is a wrought-iron cistern, which is kept supplied by two lift-pumps, 27 inches in diameter. Within this cistern is placed the main or forcing pump, with its ram, 36 inches in diameter. From it are the rising pipes to a large air vessel, to which is attached the main, nearly five miles long, through which the water is sent to the engines and reservoirs at Stoneferry. The engine worked very satisfactorily. All its motions seemed free and easy, and under perfect control. The steam was supplied by three new boilers, made under the engine contract. The balance-weight on the ram is heavier than is required for merely sending the water to the Stoneferry reservoirs, but will be all the better adapted for the higher pressure required for direct pumping into the town. It is expected that this object, so long desired, both for economy and purity of the water, will, before long, be accomplished; if not altogether, at least to a large extent of the water supplied.

STOCKTON AND MIDDLESBROUGH WATER COMPANY.—The half-yearly meeting of shareholders was held at Darlington on the 1st inst.—Mr. H. Pease in the chair. The Secretary (Mr. Simpson) read the directors report, which stated that for the half year ending Dec. 31st there was an available balance of £14,309 11s. 7d. After payment of all fixed charges, dividends had been declared on the original and A shares at the rate of 12s. 6d. per share, and on the B and D shares at the rate of 10s. per share. There had been an attempt at the preliminaries of a negotiation for the purchase of the undertaking on the part of the joint Corporations of Stockton and Middlesbrough, but without result, and the directors were unanimously of opinion that they would sacrifice the shareholders interests were they to depart from the policy which they had adopted. The directors had promoted a bill in Parliament to maintain the powers and position of the company in the district. The Corporations of Stockton and Middlesbrough had also presented a bill, seeking powers to supply the same district. The Chairman, in moving the adoption of the report, stated that, taking the year through, they pumped considerably less than 60 million gallons of water per week. It was satisfactory that the company had been able to pay a good dividend and leave a large margin of water to draw upon. Mr. Allison seconded the report, which was adopted. The retiring directors, Messrs. J. H. Bowman, A. Kitching, and R. Thompson, were reappointed. Mr. Geo. Allison moved that the remuneration of the directors be increased from £400 to £800, on account of the extra trouble they had been put to in fighting the battle of the shareholders in Parliament. He believed that the project of the Stockton and Middlesbrough people was one of the wildest schemes that was ever attempted. Dr. Piper seconded the resolution, which was carried unanimously. The chairman said that with reference to what Mr. Allison had said, when they looked at the enterprise of Stockton and Middlesbrough, they must not consider it an impossible undertaking that was proposed. He believed their neighbours would not quail before such an undertaking. The meeting then terminated.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

LXXXII.

Chimney Shafts or Stacks.

We find in a standard work on gas lighting, the subject of chimney-stacks passed over with a few simple observations, to the effect that a high chimney is essential for the purpose of carrying off the smoke, which, if not allowed to spread (we assume at a great elevation), would become a nuisance to the neighbourhood. It is further stated that the draught given by an ordinary coke-oven, is all that is absolutely required for the combustion of the fuel beneath the retorts, and it is recommended, in order to avoid an excess of draught, that a valvular opening in communication with the atmosphere should be made at the bottom of the shaft. Beyond these remarks, little is mentioned as to the object of this most important part of a gas-work.

These statements, however, are erroneous, because in well-conducted establishments smoke is not permitted to issue in any quantity from the chimney. It is produced principally when discharging or charging the retorts, and for the escape of this smoke other provisions, as *louvres* or air-shafts, are always made; secondly, the shaft has a more important duty to fulfil than that assigned to it; thirdly, a good draught is indispensable for economical carbonization, and the heat of a coke oven (about 1700° Fahr.) in the furnace, would be insufficient for the retorts; and, lastly, to make a valvular communication between the chimney and atmosphere, would be equivalent to diminishing the capacity and efficiency of the former, and would increase the consumption of fuel for carbonization.

It is an accepted axiom, that the success of a gas-work is mainly dependent on the operations of the retort-house, and these, in like manner, are eminently dependent on the chimney-shaft, aided by the dampers.

The high heat or vivid combustion so indispensable for working retorts, and the proper carbonization of coal, can only be obtained by having the fuel concentrated within certain restricted limits, and by a forced supply of atmospheric air, or pure oxygen. The expense of the production of the latter precludes its use; therefore, in practice, it is obtained from the atmosphere, as in the blast-furnace, the forge, the blow-pipe, &c. The chimney-stack of a gas-work is destined for a similar purpose to the appliances just named.

The effect of a good draught is to cause an ample supply of atmospheric air to intermix with the coke of the furnace, which produces the vivid combustion referred to. At the same time, the orifice of the damper, or the point of separation between the interior of the oven and the atmosphere, is proportionately reduced, and the escape of caloric at that point diminished accordingly.

But it is to be regretted that the importance of the part of a work now in question is often sadly overlooked by engineers. In confirmation of this assertion we may state that a few years ago, when visiting one of the best-managed metropolitan gas establishments, we found that there existed an orifice (similar to, but larger than, a sight-hole) in the front of the bed, and just beneath the arch of every one of the settings, from which the flames of the furnaces issued, and we were informed that only by these means could the proper heats be obtained. This was one of many similar instances of the kind which have come within our observation.

Under such circumstances, however, we have not to seek far in order to find the cause of the evil, as this arises either from the dampers being too much closed, or the flues choked, or, as in the case mentioned, where all the beds were affected alike, the shaft being too small, or the main flue obstructed at the entrance to the shaft. Either of these contingencies occurring, the flames must issue from the sight-holes instead of ascending to the shaft; and, although making an orifice in the front of the bed as described, the draught or current would be slightly increased, it would still be very far from realizing the effects of a well-constructed shaft, with unobstructed flues.

The theory of the action of the chimney-stack may be described as follows:—Air, when heated, expands in proportion to the temperature it acquires, and, by this expansion becoming lighter than the surrounding atmosphere, it possesses an ascending power, which, in a chimney, produces what is generally termed a draught or current. The force or velocity of the current will depend mainly on the difference of the weight of a given volume within the stack, and a like volume of air at the ordinary temperature of the atmosphere.

To render this clear, we may observe that, according to the best authorities, 1000 measures of air at ordinary temperatures, when heated to something like 550° Fahr. (which may be considered the average temperature of the interior of retort-stacks when in active operation), are augmented to 2000 measures; or, in other words, by the additional heat mentioned, the volume of the air is doubled. The weight of 1000 cubic feet of air, at ordinary temperatures and barometrical pressure, is approximatively 80 lbs. With these data, we shall be enabled to explain the *modus operandi* of the structure under consideration.

For this purpose, let us suppose a chimney-stack of an area of 5 square feet (about 2 feet 3 inches square), and 20 feet high above the main flue, having a capacity of 100 cubic feet. If the air within the chimney be heated to the degree already stated (viz., 550° Fahr.), it would weigh but 4 lbs., whereas the weight of a like volume of the surrounding atmosphere would be 8 lbs. The heated air, therefore, would ascend with a force equal to the difference of the two weights—viz., 4 lbs.—exerted over the area of the chimney, which force or draught would be maintained so long as the temperature remained as supposed, and the supply of air within the stack was continued.

But, if the height of the stack be 40 feet, we find the draught doubled in force; and if increased to 80 feet, all the other conditions being as represented, then the draught will be equal to 16 lbs. over the area. Thus the ascending force of the 80-feet chimney would be four times greater than that of the 20 feet, which clearly shows the importance of high stacks, and the inefficiency of the dwarf chimneys which have sprung into use at many works.

For the facility of illustration in the preceding remarks, we have confined ourselves to effects of heated air only; but, as the products of combustion issuing from the shaft are widely different from these, being composed of several compound gases, which are heavier than atmospheric air at ordinary temperatures, the results are considerably less favourable than those described. The proportions, however, under the various heights of chimney remain approximatively as indicated, subject to the influence of every change of atmospheric pressure.

The utility of a stack consists not only in its height, but in its area, being constructed in like proportion, so that the heated air or products of combustion may pass off with all freedom. A very common error committed is to contract, to a considerable extent, the stack at its summit, by which means it is supposed that the draught is increased. This, under ordinary circumstances, is just as absurd as to suppose that, by contracting a main from 10 inches diameter to 4 inches, the pressure required for the delivery of a given quantity of gas would be diminished. That, under peculiar circumstances, it may be desirable to contract the summit, there can be no question; as we once observed in a very small work, when the wind blew in a certain direction, or, as the stoker said, "chops over that hill," it was impossible to obtain any draught; in fact, at times the wind blew down the chimney, so that it was utterly impossible to heat the settings. In this case the top of the stack was materially reduced, and protected from the hill-side, which cured the evil. In dwelling-houses we frequently witness a similar evil in a chimney abutting against the wall of a building. The wind blowing against the wall, rebounds and descends the chimney, producing that most disagreeable of domestic annoyances—a smoky chimney.

The chimney-stacks of large gas-works of ordinary magnitude, however, differ entirely from that mentioned; they should never, therefore, be contracted at their summits, but, as near as possible, be of uniform area from the bottom to the top, so far as economy in construction permits, for, as will be described hereafter, within the chimney there are sets-off in the brickwork, in order to facilitate the construction.

In the work already referred to, it is recommended to place dampers on the main flue instead of applying them to the respective settings. This, after what has been stated, cannot be too strongly deprecated, inasmuch as the stack answers the purpose of the blast, the bellows, and the blow-pipe, and having such an excellent appliance, without cost or trouble, beyond its first construction, the folly of checking it by a damper must be palpable. The proper system of working is to have a good draught throughout the whole of the settings, and to check each bed carefully by its damper. In many works it would pay handsomely to have an intelligent man, whose duty might be confined to this alone, and thus prevent the loss of an incalculable quantity of fuel, which often passes uselessly and without any indication into the atmosphere.

It may be supposed that by closing the dampers of the settings, the influence of strong draught is not exercised; but the very opposite of this is the fact, inasmuch, as before stated, the damper is the point of separation between the oven and the atmosphere, and the smaller the opening of the damper, the more complete must be that separation. Thus, if we suppose, with an insufficient draught, the opening of the damper to be, say, 30 square inches, and with a good draught to be only 6 square inches, it is evident that the heat in the latter case will be retained in the oven, whilst in the former, great facilities will be afforded for its passing uselessly into the atmosphere.

To take an opposite view, in dampers of large dimensions with a good draught, the fuel will be burned with the greatest rapidity, producing heat without influencing, to any extent, the temperature of the retorts, but passing uselessly to the atmosphere.

(To be continued.)

Public Lighting at Forfar.—At the meeting of the Forfar Gas Commission, on the 17th ult., a report was brought up from a committee in reference to the street-lamps, which stated that the average amount of gas consumed by them was fully double that paid for, and recommended that the Manager and Superintendent of Police survey and make up a list of the leading and ordinary lamps; that the Gas Corporation have control of, and supply, all the burners; and that these be renewed during the lighting season. The report was remitted to a joint committee of the Corporation and the Watching and Lighting Committees of the Police Commission.

Faversham Water Supply.—The report of the directors of the water-works company in this town states that the income of the company during the past three years was, 1873, £888 16s. 6d.; 1874, £819 0s. 9d.; 1875, £886 9s. 3d.; 768 houses are now supplied with water, 43 having been added during the past year. During the past year the pumps have been kept going by steam power 1500 hours, and by wind power 2200 hours; and the windmill continues to effect a considerable saving of fuel. During the year a new well has been formed, and the headings of the old well have been extended. A valuable addition to the water supply and storeage has thus been obtained. The directors recommend the declaration of a general dividend of 6 per cent., to be paid without deduction for income-tax; and that £25 of the present balance in hand be added to the reserve fund. A balance of £131 8s. 2d. is now due to the capital account, and when new mains and services are supplied to meet the increasing wants of the town and neighbourhood, a further outlay of capital will be necessary. The directors therefore ask to be empowered to borrow, from time to time, on security of debentures, such furthur sum, not exceeding in the whole £1000, as they may consider needful.

Correspondence.

BURNER TESTINGS.

SIR,—I beg to enclose you a copy of a letter I have forwarded to the *Newcastle Daily Journal*, anent the paper of Mr. Pattinson, which you published in your last issue, as I have, with the same quantity of 14·3 candle gas, been able to obtain a better result than he has.

I trust you will kindly insert this, for the information of your readers. I send you also a set of the same burners as I have forwarded to Mr. Pattinson and the editor of the *Newcastle Daily Journal*, in order that you may verify the results I have obtained.

Vincent Works, Westminster, Feb. 5, 1876. WILLIAM SUGG.

(COPY.)

To the Editor of the "Newcastle Daily Journal."

Sir,—I saw, in your journal of Friday last, a report of the paper read by Mr. John Pattinson, the analytical chemist to the Newcastle Corporation, in which he gives the results of the testings of a quantity of gas-burners, mine among the rest. The subject of gas-burners, and the best mode of making them, so as to obtain the greatest amount of light from the quantity of gas consumed, has been my constant study for many years. The discoveries I have made have enabled me to produce better burners than have ever before been known. It has been many times declared upon oath, by the most scientific men of the day, that the Sugg-Letheby burner (designed by myself and Dr. Letheby, the chief gas analyst of the City of London) gave two candles more light, for five cubic feet of gas consumed, than any other burner known at that time—1863. The 15-hole (12 candles) Argand burner, invented by me in 1858, surpassed all previous burners, and was the starting-point of my improvements. It was then I made the important discovery that gas should be burnt at low pressure, to develop its illuminating power. From that time to the present, other burner makers have attempted to put that discovery into practice, but have not, as yet, succeeded in producing burners equal to mine. The progress I have made, in the development of the latent illuminating power of gas, is best marked by the evidence given before Parliament upon the Argand form of burner. Thus, in the minutes of evidence on the Metropolis Gas Companies Bill, 1875—

Mr. Charles Heisch, Professor of Chemistry at the Medical College of the Middlesex Hospital, and superintending gas examiner of the Corporation of the City of London, says that, in his opinion, the burner of 1864—*i.e.*, the "Sugg-Letheby" standard burner—was two candles better than the average of burners used; and, further, that he corroborates the evidence of Mr. Keates, the chemist to the Metropolitan Board of Works, in saying that the burner of 1868—*i.e.*, the Sugg's "London" Argand—shows a progressive increase over that of 1864 to this effect, that 5 feet of gas which by the burners in use in 1860 would give a light of 12 candles, will now, by the use of Sugg's "London" Argand Standard burner, give a light of 16 candles. The improved "London" Argand, such as is now regularly purchased by consumers, shows a further progressive increase, and that you may judge of its excellence, I have forwarded to your address a specimen taken at hazard from the counter, where it was lying with others, part of an order just being executed. This burner was carefully tested by three operators (one of them being myself) upon a photometer exactly like those I have made for the Government of Canada, which bears the stamp of the Standards Department of the Board of Trade.

The result was as follows:—No. F. Sugg's patent "London" Argand improved, consuming 5 cubic feet per hour of gas (equal to 14·3 candles tested by the Sugg-Letheby burner), with 6 inch by $1\frac{3}{8}$ inch chimney, gave a light equal to 18·60 parliamentary sperm candles.

I afterwards, with the same quality of gas, tried the under-mentioned burners. Sugg's patent "Christiania" flat-flame burner, with self-acting governor, for maintaining uniformity of pressure, consuming 5 cubic feet per hour, gave a light equal to 16 parliamentary sperm candles.

Another burner of the same kind consuming 4 cubic feet per hour, gave a light equal to 13 parliamentary sperm candles.

Also, two Sugg's "Winsor" screw regulating flat-flame burners, one for 4 feet per hour, giving light equal to 12·80 sperm candles, and one for 5 feet per hour, giving light equal to 15·50 sperm candles; two Sugg's "Clegg" pattern brass-cased burners, one for 4 feet per hour, giving light equal to 12·90 sperm candles, and one for 5 feet per hour, giving light equal to 15·60 sperm candles.

These other burners I have sent in the same parcel as the Argand burners, in order that you may, if you please, satisfy yourself as to the correctness of the results above stated. In adopting this course, I am actuated simply by the desire of having justice done to my productions, and without any wish or intention to find fault with Mr. Pattinson's experiments. From some cause or other, he has not been able to develop the possible amount of light to be got out of Newcastle gas. I think it probable that he has not been in possession of my latest improved burners. In order that he may see whether there is any difference between those he used in his experiments, and those I have the honour to submit to you, I have forwarded to his address, through my agent, Mr. Halliday of your city, a similar parcel of burners.

Hoping that you will give this the same publicity as you gave that of Mr. Pattinson,—I am, sir, your obedient servant,

(Signed) WILLIAM SUGG.

Vincent Works, Vincent Street, Westminster, Jan. 31, 1876.

SIR,—In your issue of the 1st inst., there appears a report of a lecture delivered by Mr. M'Crae, in the Free Library at Dundee, in which reference is made to Brönner's burners, and a table of experiments given, which is somewhat misleading to the general public. As the figures do not appear to be correct, they should not pass without our drawing attention thereto, we being Mr. Brönner's sole consignees in Great Britain and Ireland for the sale of his gas-burners.

In the table of experiments alluded to, we notice that Brönner's burner, at a pressure of 1 inch, gives a light of 14 candles, with a consumption of 2·2 cubic feet per hour, which, if calculated to 5 cubic feet consumption, would give 31·8 candles instead of 22, as reported.

Mr. M'Crae observed, during the course of the lecture, "You are not to suppose there is any virtue in this kind of burner." We think Mr. M'Crae cannot have studied the principle which has guided Mr. Brönner in introducing his improvements in gas lighting, or we scarcely imagine he would have made use of so strong a condemnatory remark. On the contrary, we maintain there is a great deal of practical usefulness in M. Brönner's invention, as will be seen by the following description, which is taken from the paper read before the Philosophical Society of Glasgow in 1874, by Dr. W. Wallace, F.R.S.E., F.C.S., gas examiner for the city of Glasgow.

He says: "This," meaning Brönner's burner, "is a rather wide brass cylinder, tapered at the bottom, and having at the top a short steatite burner, which screws in. At the lower or contracted end a piece of steatite is inserted, in which is an oblong slot. The gas has to force its way through this slot, which has a smaller area than the slit at the top, and it expands into the brass cylinder, and escapes through the slit, at a pressure of from 2-10ths to 5-10ths of an inch. The rate of consumption is, therefore, dependent on three conditions—first, the area of the opening at the bottom; secondly, the area of the slit of the burner; and, thirdly, the initial pressure of the gas." There are 11 different sizes of bottoms, and 16 different kinds of tops, each top being adapted to the quality of the gas to be burnt, some being for cannel, and some for common coal gas, and are interchangeable with any of the sizes of bottoms. There is thus a large variety of combinations of burners, thus affording a most extensive selection to suit any description of gas, or any standard of pressure; and it is the business of the gas-fitter to study the circumstances which prevail in the position where any one of these combinations is to be fixed, a care which, unfortunately for the public, cannot be taken when the gas-burners which are in general use are employed.

It must be borne in mind that Brönner's burners were expressly introduced for the purpose of checking undue pressure, and while we agree with Mr. M'Crae, that a good result can be obtained by burning gas through a large burner at a low pressure, yet we find the public do not adopt large burners; because a slight increase of pressure causes the gas bills to become unduly large; but in Brönner's burners the orifice at the base may be compared to the small burner in general use, while the top is adjusted so as obtain the largest amount of light from the same quantity of gas as consumed by the old burners.

If, then, these combinations of inlet and outlet orifices were introduced by the various gas companies, there would be an end to the complaint so frequently made to gas managers of bad quality of gas, and their customers would derive the benefit of increased light, with a corresponding diminution of the vitiation of the atmosphere of the apartments.

The public importance of this question will, we trust, be sufficient excuse for our troubling you with this rather long description.

155, *Cannon Street, London, Feb. 4*, 1876. H. GREENE AND SON.

APPOINTMENT AND REMUNERATION OF GAS COMPANIES SECRETARIES.

SIR,—A corner in your "Notes and Queries" for the questions raised below, would greatly oblige.

The Companies Clauses Act, 1845, clause 91, says: "Except as otherwise provided by the Special Act, the following powers of the company (that is to say) . . . the choice of directors, the determination as to the remuneration of the directors, auditors, treasurer, and secretary . . . shall be exercised only at a general meeting of the company."

In the Special Act, 1846, under consideration, the word "secretary" is in no way mentioned; but in an Amendment Act, 1848, the secretary is "ordered" in several clauses.

The Special Act provides and authorizes the directors to employ such clerks and other servants as they may deem requisite for carrying into effect such of the provisions of this Act as relate to the said company or the directors thereof, and to allow them such salaries or remuneration as such directors shall think fit, out of the funds which shall come to their hands by virtue of the Act."

Now, first: In whom does the appointment and election of a secretary rest, and is he a "clerk or other servant," as designated by the Special Act? Secondly: A secretary having been appointed several years ago at a general meeting, should the amount of his annual stipend be ordered and fixed by the board of directors, or by the shareholders at a general meeting? The interpretation clause of the Companies Clauses Act says the "secretary" shall mean the secretary of the company, and shall include the word clerk.

Now, first: Does "clerk" include the word secretary? If it does, the secretary, as a matter of standing, is reduced from what is considered an important and influential position, to be rated among the office clerks or other servants of the company. Or, secondly: Does he take rank and place, in election by the shareholders, with the directors, auditors, treasurer [and secretary] of clause 91, Act 1845? Thirdly: Can the secretary be elected, to act legally, by any body except shareholders in general meeting? I. N. K.

[Unless the special Act referred to by our correspondent incorporates the General Act of 1845, we should think the appointment and remuneration of the secretary rests with the board.—ED. J. G. L.]

GOVERNORS TO METER-LAMPS.

SIR,—I observe the letter of your correspondent, Mr. Thos. D. Hall. As public lighting has been a subject of constant study by me for many years, I am not at all adverse to giving him some "light" on the subject; but, from the absence of my statistics, at present I cannot enter into such details as I may at another time, and by other means, make known.

In six towns during the past two seasons I have had the control of public lighting, adjusting of governors, &c., and am now in a position to say that lamp-governors are indispensable, and are practically correct, under the following circumstances—viz., that the burners used in all the lamps be the same, and unalterable, not liable to get larger or smaller; that the pressure on each governor be the same; that the diaphragms of leather in all weathers of moist, warm, dry, or frosty, be also unalterable; and that the degree of opening and closing of the valve be in exact ratio to the varying pressures, always maintaining a given pressure on the jets.

These constants being maintained, I assert that the lamp-governor will pass exactly what it was set to do. It is a finely manipulated machine; but, unfortunately, is a victim to circumstances, and very liable to derangement, owing chiefly to the nature of the diaphragm to which the cone is attached.

I have personally tested hundreds of these governors under different pressures, after they have been in use for two or three years, and I have almost invariably found, so far as I can remember, that there was, at least, a variation of about 15 per cent. in increased registration with every 5-10ths of increase of pressure, and *vice versâ*. Having ascertained this fact, which in no way invalidates the average by meter, as all governors are equally affected by pressure in the various districts the meters may be placed in, I made it a practice of having all lamp-governors brought into the meter-shop annually, and, with the aid of the 5-feet gasholder and minute clock, applying our average maximum pressure, I carefully adjusted each by adding or diminishing the weights, and making them ready again for the season. This I have done in presence of the lighting inspector for the corporation.

It will thus be seen that lamps having a meter placed on them, have their governors exposed to the reduced difference of pressure—namely, they will have a pressure less than the pressure on the non-meter lamps, to the extent of the pressure absorbed in working the meter.

The duties of the lamp-governor I do not ignore. As it is made at present, I consider it sufficient in every way, and it does all the duties I expect of it. Perfection is, perhaps, inaccessible; still, it remains for the more ingenious amongst us to invent an instrument, as a lamp-governor, that will, under all variations, pass the exact number of feet per hour it is made and given out for, in the varying circumstances of dry, wet, hot, and frosty weather. Then in place of "average meters," I will only have one or two "average clocks," with dials of tens, hundreds, and thousands of hours, to be set in motion by touching a small lever in conjunction with that on the lamp when lit, and turned off in the same way when the lamp is put out. Thus the hours only will be registered, and the number of governors will give the exact number of feet consumed per hour, and neither "wet" nor "dry" meters will any longer be to blame. Unfortunately, however, this is all moonshine.

The duty of a lamp-governor in the average meter system *is not* to tell us what gas has been consumed. It is to govern equally over all the lamps alike, the delivery of gas to the jets, according as the pressure is put on or off the mains, such pressure to affect each governor alike. It remains for the meter to say what has been consumed, whether 5 feet per hour while two inches pressure was on, or 2½ feet when one inch was on, is of little consequence, so long as it prevents the direct blowing of gas from the mains through a faulty burner, and in a marked degree aids in maintaining a uniform size of flame.

I will now state that while it is of the highest importance to consume gas in such a manner as that the greatest illuminating power is obtained by a jet consuming, say, 5 feet per hour, while burning 18-candle gas, still, by employing these means, the liability to loss is greatly increased in public lighting, and watchfulness becomes more necessary, in so far as having suitably large jets fixed in the governors, before testing them to pass 5 feet per hour, so as to give a full flame without apparent pressure, or the least sign of smoking. In winter months, during the day, when the pressure on mains is at its minimum, the diaphragms get rigid, so that when the pressure comes on at night, it does not close up as usual, and the gas passes in greatly increased volumes. I have, in this way, found 10 feet per hour passing, and on a number, which I ordered into the works for testing, I found an average of 7 feet per hour in place of the 5 feet stated. I was led to take off the governors on these to satisfy myself as to their utility, and with 25-10ths pressure got on the meter a rate of 20 feet per hour through the jet.

No doubt this liability to loss could, in a great measure, be remedied, by fixing a jet, which, under the maximum pressure, would consume only the stated 5 feet per hour. By so doing, the duty of the governor is superseded by the jet, at a large per centage of loss of light from the gas actually consumed. I have found upwards of 30 per cent. of light can thus be lost.

A few weeks ago I passed through a little town in Scotland, illuminated by a very religious light—insomuch that, in passing along the streets with another gas manager, the idea suggested itself of getting a "penny caunel" to see the lamp-posts, which were surmounted by lights, as if a "glow-worm" had been placed on each jet; and instinctively, in passing, I took a step to one side from the pillars, for fear of touching them and shaking the light off the top. The uniformity of these "sparks" was something very remarkable; no governors were, however, in use, and I confess they were not at all indispensable. A good burner and a common cock would have been a great improvement in a town enjoying the supply of 28-candle gas, in place of the bad and dirty jets which our friend mentions. The "governor" in this case had an example of careful manipulation.

If you will allow me, I will point out a possible cause of error, and perhaps further the ends of this controversy, by enabling others to make known their experience. In ordering lamp-governors from the makers, I used to say, "Send to this company so many governors, with jets, set to pass five feet per hour." Now, managers receiving these, and straightway proceeding to fit them upon lamp-posts, being assured that the makers guaranteed them to have been tested before sent out, will, by taking a little precaution and time, discover their mistake. I have every reason to think the subject has not received the general attention it deserves. The fact is, that the difference in the quality of the gas in the towns in which the governors are to be used, as compared with that in the town where they were made and tested, is sometimes a serious cause of error.

In ordering, the safest way is—first get a few governors new from the maker, put in the jet you are uniformly to use, test these by your test-meter under the average maximum pressure on the lamp-pillars, and, using the average quality of gas you intend supplying, adjust the weights till you have the desired consumpt per hour. Then send these governors and burners to the makers as samples—the others will come very nearly correct. I would add to this a recommendation that managers should test street-lamp regulators every year, when they will find more than will amuse them.

I have ventured thus far as the result of my own findings, but I do not assert that I am correct, so as to be taken as a standard for everybody. Let others do likewise, and by their findings I will be open to be corrected, should my assertion as to testings of governors for meter lamps, and for non-meter lamps, be not very near the mark.

I would also suggest that the inspector for public lighting, on behalf of the public, be present at the annual inspection and adjusting of lamp-governors.

In reply to your correspondent's queries, I simply have to inform him, regarding the first one, that, in my opinion, all lamp-regulators should be exposed to the same pressures and variations, and that the variations are of little consequence, so long as the governor on the meter-lamp has a pressure on it, after passing the meter, equivalent to that on non-metered lamp-governors. His second question—viz., the advantage of a governor over a common cock or well-made burner, I think I have already answered, and shown by testings; but I fear it will be a very difficult thing for anybody to convince your correspondent, who, in his opening remarks, asserts that it is unsafe to believe anything we hear, and only safe to believe one-half of what we see.

Glasgow, Jan. 25, 1876. WILLIAM KEY.

SIR,—As there have been several letters on the subject of my inquiries of the 18th of December, will you allow me to say a few more words. One writer informs me that an allowance is made; another gives the qualifications of a governor, providing the pressure does not fall so low as to let it go out of action; and another gives examples of testing, but not at a less pressure than 10-10ths, and it appears to me that this is the particular point, for I have proof that, in first ordering governors, there is often the mistake made, for they are ordered to pass a given quantity, and no mention is made of the pressure to which they will be subject.

As an example, I have recently tested one used for the average meter system, and set as above; the result is that at 4-10ths it passes 3·1 feet, 5-10ths 3·5 feet, and so on, till 10-10ths is reached, when it passes 4·6 feet, which cannot be increased. Now, as the pressure in many towns falls below that (10-10ths) at the works in early morning, when little else than a few public lamps are alight, the loss must be very considerable, and the only remedy is to have the whole of the governors set to pass the given quantity at the lowest possible pressure. No doubt when a manager finds that the whole of the governors to his lamps are set at a pressure above his minimum, and as the meter ones are the first to feel the effect of a reduction of pressure, he feels bound to, at least, have those set to work at a less pressure. This may be the case at Clitheroe or Accrington.

I have had a governor offered to me that will pass 5 feet per hour with 5-10ths pressure, and as, I am sorry to say, only apologies for governors are used by our Lighting Committee, which vary from 1·6 feet with 4-10ths, to 4·9 feet with 27-10ths pressure, and as the lamps pass to the corporation control in May, I think it high time we enforce the use of the governor to the whole of the lamps. It was for the substantial information I hoped would follow my inquiries, that I made them, trusting some good may follow them.

Gas-Works, Hertford, Jan. 29, 1876. R. W. BRETT.

STATION GOVERNORS.

SIR,—Replying to the observations of your correspondent, Mr. Jarvis, who supposes a fallacy to be conveyed in the remarks on "Governors" in page 83, I wish to state that, in my opinion, such is not the case; but that your correspondent himself is entirely in error, in supposing "the downward pressure on the sides of the cone exactly equal to the upward pressure at its base." The sole object of the governor is to separate the heavy pressure beneath its cone from the light pressure within its holder. It is clear, therefore, that Mr. Jarvis labours under a mistake. Indeed, if it were as he imagines, of what use would be the governor?

For the purpose of explaining my views, I will suppose a governor, receiving its gas from a holder giving 10 inches pressure; that this is required to be adjusted by the instrument to 5-10ths, for delivery to the town; and that, the consumption in the daytime being limited, the cone is then lifted almost to its extreme height, leaving a very small annular space of, say, one-hundredth part of an inch wide, to supply the quantity of gas required. Under these conditions, the whole of the 10 inches pressure would be exerted on the under part of the cone, less that of the annular space, at which point the gas is reduced from 10 inches to 5-10ths pressure.

Now, if we assume the area of the under part of the cone to be 100 square inches, the whole of the high pressure would be exerted on this, less one-third of a square inch, corresponding with the area of the annular space referred to, the influence of which is so slight as not to be worth consideration. This, it is true, is an extreme case; but as the pressure is always reduced when passing the orifice of the valve, it followe that the high pressure is exerted on the cone base.

Your correspondent is also of opinion "that no change of pressure on any part of the cone can affect the action of the governor." From this I also differ. This, as we gather from the article in question, will mainly depend on the area of the holder of the governor, and as is there also mentioned, "when this is 15 or 20 times the area of the cone, the changes in pressure are slight;" "but when the holder is but a few times larger than the cone," "the variation in operation becomes very serious." The reasons of this defect are given in the context of the article; but it must not be inferred that a permanent variation in the delivery of the gas is produced. As I understand the question, it is merely a temporary variation until the holder rights itself, and even this can be avoided by having it of ample capacity.

Although I am not *mathematical*, I trust your correspondent will be satisfied with this explanation. B. T.

GLOBULAR STREET-LAMPS.

SIR,—I have a little information to ask respecting some globular lanterns for street-lamps, that the Lighting Committee of this borough have lately introduced. Since their introduction I have been continually troubled with breakages, and as the lamps are in one piece, and not in segments, there is no sending your glazier to put a square in, but a breakage means a new globe. My opinion is they will become very expensive. The remedy may be simple enough to those who know it; but I am not in possession of it, hence I ask some of your numerous correspondents if they can give me any information how to avoid breakages, without doing away altogether with this form of lantern. The following are particulars of the globes named:—

Size of burner, No. 2, Bray's.
Consumption of gas per hour, 4·5 feet.
Quality of gas, 17 to 18 candles.
Diameter of globe, 20 inches.
Hole top and bottom, 4½ inches diameter.
A well-ventilated coronet on the top.

JOHN HENRY LYON, Manager.

Macclesfield Corporation Gas-Works.

REMOVAL OF CARBON FROM, AND A REMEDY AGAINST THE DEPOSIT OF CARBON IN, RETORTS.

SIR,—Though Mr. W. D. Cliff has "read again and again" my letter in your issue of the 11th of January, it seems that he has overlooked that there are two proposals in that letter—one for facilitating the removal of carbon from, the other to prevent its deposit in, retorts. I might know if, from his "manufacturer's point of view," both the proposals seem "so simply absurd."

I have read Mr. Cliff's letter with the greatest attention, and still its meaning is not clear to me. I cannot suppose that he means to answer

my letter by simply saying, "Your proposal is absurd," without giving any reason for this opinion. If, on the other hand, I must find the reason of the absurdity of my proposal in the unwillingness of gas companies "to pay a slight extra cost for first-class retorts, worth double the money to gas companies, to many that are in the market," I should rather apply the epithet "absurd" to this unwillingness of the gas companies. Mr. Cliff accuses the gas companies or their superintendents of not regarding their own interest by buying first-class retorts, and only asking for low prices. I, for my part, and for the part of many engineers of my acquaintance, cannot accept the accusation, as I know that "quality is always worth paying for," *when the superiority of the quality is worth the money that is asked for it.*

Now, I must confess that, in consequence of the letters of Mr. William Young and of "Nemo," I am aware that I have accepted too rashly the statement of Mr. Tysoe, and that the primary cause of carbon deposit is the decomposition of the hydrocarbons by high heat, aided by pressure. This induces me to doubt the assurance of Mr. Cliff, "that clay retorts can be, and are, made, in which the deposition of carbon is materially reduced."

The only improvement that can be attained, in regard to the deposit of carbon, is, I believe, to make the retorts in such a way that the carbon may be easily detached. And as this property differs materially in retorts of various manufacturers, and even sometimes in different retorts of the same manufacturer, I take the liberty to recommend this question to their study and attention.

C. T. S.

R . . . . . ., Jan., 1876.

Parliamentary Intelligence.

GAS AND WATER BILLS, 1876.

MONDAY, JAN. 31.

The Examiners found the Standing Orders complied with in the following unopposed petitions for Private Bills:—Southport Improvement, British Gaslight Company (Hull Station), Bristol United Gas, Sevenoaks Gas, Gorleston and Southtown Gas, Sutton Gas.

TUESDAY, FEB. 1.

The following unopposed petitions passed Standing Orders:—South Metropolitan Gaslight and Coke, Imperial Gas, Burntisland Burgh, Kirkcaldy Burgh and Harbour, Dunfermline Water, Uppingham Water, Tipton Local Board, West Bromwich Improvement, Shepton Mallet Water.

Legal Intelligence.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

WEDNESDAY, JAN. 17.

(*Before Vice-Chancellor* BACON.)

PATTERSON *v.* THE GASLIGHT AND COKE COMPANY.

Mr. DAVEY resumed his argument this morning, and said the first claim made by the plaintiff, as novel and original, was for sulphide of calcium in separate purifiers, as a means of purifying coal gas from sulphur in other forms than sulphuretted hydrogen; but he said nothing about it having been previously purified from carbonic acid. In support of that contention the case of *Arnold v. Bradbury* had been cited; but he submitted that the words "as hereinbefore described" could not be read in the first head of the patent. The specification, quite apart from the claim, showed that he did not deem the previous purification of the gas from carbonic acid to be indispensable to that head, because he said it was not indispensable that the whole of the carbonic acid and sulphuretted hydrogen should be taken out, but simply said that the more you took out the longer would the sulphide of calcium remain efficient. In the claim the plaintiff had put forward as being novel and original, he had confined himself to sulphide of calcium in separate purifiers. In *Arnold v. Bradbury*, the patent was for making ruffles by the machinery particularly described in the specification; the case came on without evidence, and the court was asked to say, on the face of the specification, that the claim was too wide, as it claimed the production of ruffles, frills, and so forth, by machinery of every kind—not confined to the machinery in the specification—and Lord Hatherley, in deciding the case, said, in the absence of evidence, he could not hold that the claim was too large. But in *Jordan v. Moore* exactly the contrary was decided. In the ordinary mode of working, having regard to the chemical action of carbonic acid driving off the sulphuretted hydrogen at the moment of saturation, the later purifiers would be separate purifiers containing sulphide of calcium. That that was so was clear from Dr. Odling's cross-examination; for he stated, assuming the gas contained three volumes of carbonic acid and one of sulphuretted hydrogen, and if the purifiers were full of fresh lime, it would go on absorbing absolutely carbonic acid and sulphuretted hydrogen, not exactly in the proportions in which they were there present, because carbonic acid was more readily absorbed than sulphuretted hydrogen, but it would take more than three parts of carbonic acid to one of sulphuretted hydrogen. There would be a mixture of carbonic acid and sulphuretted hydrgen with every part of the lime; but the mixture would be in very different proportions—that where the gas went in would be substantially converted into carbonate of lime with a little sulphur, and that where the other went in would be sulphide of calcium with a very little carbon. The purifiers ordinarily consisted of several trays; and, substantially, if gas were passed through up to the point of saturation, the effect would be that the lower trays would be wholly carbonate of lime. The action was a preponderating action, and not a substantial action. The top layer would be substantially pure sulphide of calcium in the same sense as the lower would be pure carbonate of lime—neither would be quite pure. The point of saturation was where the sulphuretted hydrogen began to come, supposing that the gas were passed through slowly enough for the two elements to be absorbed; they might be passed through so quickly that neither could be absorbed. Supposing them to pass through until the lime became saturated, the first indication would be the coming off of sulphuretted hydrogen.

Mr. KAY: Will my friend read the next question.

Mr. DAVEY: Certainly. He says he believes it would take 48 hours in such an apparatus as that in use at Beckton for the operation to take place. He had never been on the works continuously long enough to make the test; but believed that in 48 hours sulphuretted hydrogen began to come off. In re-examination he stated whenever one had a series of purifiers through which to pass the gas until the carbonic acid was taken out from the sulpuretted hydrogen, more or less of the latter layers would consist almost entirely of sulphide of calcium. He submitted that where lime purification was employed to take out the sulphur compounds, the plaintiff's claim for the employment of sulphide of calcium in separate purifiers could not be considered as novel. It was admitted that it was only in the form of sulphide of calcium that the lime would operate on the sulphur compounds, and he submitted that wherever lime purification was used in the manner described by the defendants witnesses, they had the employment of sulphide of calcium in a separate purifier for taking out the sulphur compounds. Dealing exclusively with the first head of the patent, he would ask his lordship to consider the significance of the mode of working which had been proved to have taken place at Bow. When the purifier was still operating on the sulphur compounds, when the lime in the first purifier was easily taking out the sulphur compounds, the first purifier was changed and thrown out of action, and the significance of that was that the lime was still taking out the sulphur compounds, and, therefore, the sulphuretted hydrogen had not been all expelled. If sulphuretted hydrogen was passing from the first to the second purifier, it showed that the second purifier was in a state of sulphide of calcium, for the reason that sulphuretted hydrogen, being a forerunner of carbonic acid, showed that in substance no carbonic acid could be passing into the second purifier, or, in other words, that the second purifier, at the time when the first was changed, was still in a state of sulphide of calcium. Even supposing his friends were right in their construction of the patent, for it was purely a question of construction, then he submitted that Mann's patent was an anticipation, as that was also for the treatment of gas with sulphide of calcium. It had been said that Mann's patent was unworkable; but he did not think that statement could be supported in the face of Mr. Keates's evidence. The priciple laid down by the authorities was, that where you had a patent for carrying out a principle, or an idea, and the patentee described the mode in which it was to be carried out, if that were shown or proved to be inefficient, and a subsequent patentee supplied the details wanting in the original patent, the second patent might be maintained as an improvement on the first, notwithstanding it covered the first patent. No doubt the plaintiff's patent was the more detailed of the two, and supposing he had taken out his patent first, if it were a good one, beyond all question Mann's patent would have been an infringement of it. The proper test to put in cases of this nature was—would the first patent have been infringed by the second? He would not occupy time by comparing the specifications, as that had been already done by his friend, but would merely ask his lordship to consider which was the more detailed and specific of the two. Turning to the second head of the patent, his lordship would note that the gas was to be passed through the first lime purifier or purifiers, not until the first purifier showed carbonic acid, but for such time as that the carbonic acid should have expelled the sulphuretted hydrogen. He quite agreed that if they adopted the theory (which they asked the court to do), that sulphuretted hydrogen was the forerunner of carbonic acid, it would mean the same thing. Unless that theory were adopted, and if what was said by the plaintiff's witnesses in reply were taken as true, that sulphuretted hydrogen was not the forerunner of carbonic acid, but the carbonic acid frequently came forward, even before sulphuretted hydrogen, or simultaneously with it——

Mr. KAY reminded Mr. Davey that Dr. Odling said that was only when it was passed through too rapidly.

The VICE-CHANCELLOR remarked that the phrase occurred first in Dr. Letheby's evidence.

Mr. KAY agreed that, if the gas was passed through slowly enough, it was the forerunner.

Mr. DAVEY, continuing his argument, said Mr. Kay, in his opening, adopted the expression of Dr. Letheby, subject to the qualification that the gas should be passed through the lime at a proper speed. If so, he agreed that the test for carbonic acid at the first purifier would show, not with perfect accuracy, but with sufficient accuracy for practical purposes, that the carbonic acid had expelled the sulphuretted hydrogen into the subsequent purifiers. But the expression used was that it was to be done until the sulphuretted hydrogen had been expelled. The plaintiff said he had been the first to turn to practical account the greater affinity which carbonic acid had for lime. He recommended two sorts of tests which, he said, might be advantageously used. But the testings, either at the inlet or the outlet of the purifiers, formed no part of the invention, although by practical observation and empirically the process might be worked.

Mr. KAY interjected the observation that then it would not be done empirically.

Mr. DAVEY differed as to the meaning of empirically, and said it would be empirically done if you found out by experience that, after a certain number of feet had passed through, carbonic acid would be shown. If the patent were worked in that way, changing it after a certain number of feet had passed through the purifier, it would be an infringement.

Mr. KAY said if it were discovered that, after passing so many feet through, the carbonic acid were taken out from the first purifier, and the process was worked according to that, it would be an infringement.

Mr. DAVEY was much obliged for the admission, but he supposed a correction must be made to this extent—that the sulphuretted hydrogen should be expelled.

Mr. KAY: Until it takes out as much carbonic acid as it can.

Mr. DAVEY said the patentee did not say that. The way in which it was to be done was, not to work until the carbonic acid came from the first purifier, but for such time as the carbonic acid should have expelled sulphuretted hydrogen. The words showed that the process was to pass the gas through the first purifier, for such time as the carbonic acid should have expelled sulphuretted hydrogen.

The VICE-CHANCELLOR observed that certain tests were suggested, but they were no part of the patent. It was a patent for a process.

Mr. DAVEY: Principle and process.

The VICE-CHANCELLOR said the patentee had enunciated a process, and in the course of stating that he said, if it were desired, they might test in such-and-such a way; but that was no part of the patent—that was upon the surface.

Mr. KAY quite concurred in that view.

Mr. DAVEY said, if he might respectfully say so, he acceeded to it, but the plaintiff's witnesses did not. They treated the patent as if it were for testing for carbonic acid. It was now asserted that the testing was no part of the patent, but it was for the process described. The first observation he had to make upon that was, to ask his lordship whether that process, now that it was known what was done before the patent was taken out, was rightly subject to a patent. The patentee did not suggest any new apparatus. He said they might employ their lime purifiers, which were as good as could be for the purpose. He did not suggest any improvement in the material. They were still to employ slaked lime. He did not suggest any new system of working, because working a set of four purifiers, with three on and one off, was as old as lime purification itself. There was no new application of the process to a new subject. All the patentee suggested was that they should carry out the same system of working the same apparatus with the same object, only that they should throw out the first purifier rather more often than had been done previously. If it had been a patent for testing for carbonic acid, and had supplied tests which were applicable, he could understand it. But it was not so. The patentee said tests were not necessary, although they might advantageously be used. The only clue which the patentee said he could give as to the time when they were to draw out the first lime purifier, was when the sulphuretted hydrogen had been expelled by the carbonic acid. That only amounted to a practical direction to the gas manufacturer using the apparatus. The process, if a process at all, was summed up in this, that they were to use the older process regulating the action of the first purifier so employed. He ventured to say that there was no case in the books where, for the regulation of an existing process, employing the existing apparatus for an old object had ever been held to be the proper subject of a patent. The only case referred to was the unre-

ported case of *Bovill v. Carvan*, which had already been dealt with. To make that like the present case, it should have been proved the old purifiers were not capable of being worked in the way pointed out in the specification, and that the patentee had suggested some alteration in, or some small addition to, the purifiers, which rendered them capable of being regulated so as to be worked in the way mentioned. But no alteration was required, no addition, no supplemented instrument or machinery for the purpose, it was solely and simply saying that the purifiers must be regulated in the way mentioned. It was not suggested that the present system of working the purifiers in rotation was not perfectly accurate to produce the result which the patentee desired to obtain. *Kay v. Marshall* was clearly in point upon that. That was the case of a patent for regulating the use of a well-known spinning machine. It was proved that people had been in the habit of regulating the spinning machine as they required, at a certain distance between the rollers. But the patentee took out a patent for keeping the rollers at a fixed distance of 2½ inches, and it was held that that was not the proper subject of a patent.

Mr. KAY said it would be found that the regulation of the length had been done for cotton, and that the patent was for a regulation as to flax.

Mr. DAVEY said the patentee claimed the use of the machine, regulated at a distance of 2½ inches, which was a shorter reach than had before been adopted.

The VICE-CHANCELLOR said he did not understand that Mr. Davey used *Kay v. Marshall* in any other way than Mr. Southgate did.

Mr. DAVEY said no doubt it came round to the same point, but no case had been cited in which the mere regulation of an old system of using an old apparatus had been held to be the proper subject of a patent. But could what was claimed in this case be called either a new manufacture or a new process? The process of employing lime in purifiers, used in rotation, had been known as long as lime purification had been in existence. The only suggestion was that the first purifier should be thrown out rather more often—namely, that whereas, according to the plaintiff's statement, lime purification was often worked in such a manner that carbonic acid was allowed to escape in the second purifier, that should be prevented. Suppose a man had found by experience that, if he passed a certain number of feet of gas through the purifiers, the first purifier of the series would probably contain no sulphuretted hydrogen; and he had found by experience that, by passing so much through, he obtained a good result as to sulphur compounds. What he wanted to do was to get rid of sulphur compounds. Would a gas manufacturer be sent to prison for the infringement of a patent, because he worked his purifiers in that way, when it was not worked directly with the object of expelling the sulphuretted hydrogen, but because he wanted to get rid of the sulphur compounds, although the period might be the same to do the one as the other? If the patent were for testing for carbonic acid, that would be a different thing. But, if all you could say was that a man had been passing a certain number of feet of gas through the purifiers, and that that, in its chemical action, worked the purifiers in such a way that the sulphuretted hydrogen was expelled from the first purifiers, nobody could call that an infringement of the patent; but, if the plaintiff's contention were right, that would be so. He (the learned counsel) submitted that, upon the evidence as it stood, his lordship would come to the conclusion that the very indefinite way of working the lime purifiers which he had suggested was what had been done by previous gas manufacturers. The point of this part of his argument, and the cardinal observation upon that, was that the practice, before the date of the letters patent, at other gas-works than Bow, was to change the moment sulphuretted hydrogen was shown in the second or third purifiers. That completely disposed of the plaintiff's observation that, when sulphuretted hydrogen was passing, carbonic acid might be passing with it, and the whole of the carbonate purifiers, or nearly so, might be in a state of sulphuretted hydrogen. That was so after the purifiers had shown sulphuretted hydrogen for a lengthened time. No doubt the purifiers became more and more carbonated.

Mr. KAY said he thought his learned friend admitted that if it was sent through too fast, sulphuretted hydrogen and carbonic acid might come off from the first.

Mr. DAVEY did not admit that; but if so, then it was destructive of the plaintiff's patent. He assumed that when gas was passed at an improper rate of speed through the lime purifiers, sulphuretted hydrogen was the forerunner of carbonic acid.

Mr. KAY quite agreed it would be so at a proper rate of speed.

Mr. DAVEY contended it was proved that unless the gas was passed too rapidly through the lime purifiers for the chemical action to operate, the chemical action was that the carbonic acid drove forward the sulphuretted hydrogen, and that sulphuretted hydrogen was the forerunner of carbonic acid.

Mr. KAY reminded Mr. Davey that Dr. Odling, in cross-examination, said you might pass it through so quickly that neither would be absorbed.

Mr. DAVEY was arguing upon the assumption that, unless the gas were passed too quickly through the lime purifiers, the chemical action was that both would be absorbed. Wherever the gas manufacturer worked properly, and passed the gas through the lime not too quickly for the chemical action to operate, the chemical action was in the way Dr. Odling described—namely, that at the point of saturation the first purifier or purifiers would be sulphide of calcium. If the gas were passed forward too rapidly, so that the carbonic acid overtook or got beyond the sulphuretted hydrogen, then that was equally fatal to the plaintiff's patent. But he assumed that the gas would be passed with sufficient slowness through the lime purifiers for the action to take place. Arguing upon the assumption that the gas manufacturer knew his business, he contended that the mode of working described by Dr. Redwood, Mr. Kirkham, Mr. Brothers, and Mr. Spice was an anticipation of the plaintiff's patent. Assuming the gas contained two parts of carbonic acid to one of sulphuretted hydrogen, and assuming that the sulphuretted hydrogen was the forerunner of carbonic acid, subject to the qualification agreed upon, then he said the mode described was an anticipation of the plaintiff's specification under the second head; because at the point of saturation the lime was partly carbonate of lime and partly sulphide of calcium. In what way would the sulphide of calcium and the carbonate of lime be arranged at the point of saturation? Exactly in the way described by Mr. Keates and Dr. Odling—namely, the first purifier would be carbonate of lime, and the second purifier sulphide of calcium. That was exactly what was published by Dr. Letheby in 1870. What was the answer attempted to be made by the affidavits, in reply to what the defendants had proved? First, that what was done was done empirically, and the principle was not understood. It was a very old remark that people who reasoned before Aristotle enunciated the processes of reasoning; and it really did not matter whether the thing were done empirically or not, if that which was done was identical with the plaintiff's alleged invention. The system of testing for sulphuretted hydrogen was introduced, and the defendants said that that system did ascertain what the plaintiff desired—namely, when the sulphuretted hydrogen was being expelled from the earlier purifiers. The second reply—denying the theory that sulphuretted hydrogen was the forerunner of carbonic acid—was found particularly in Mr. Heisch's affidavit. He said that Dr. Letheby's statement that sulphuretted hydrogen was the forerunner of carbonic acid was not true, because if the carbonic acid existed in the gas in larger quantity than sulphuretted hydrogen, the two gases would pass forward to the purifier together, or the carbonic acid might precede the sulphuretted hydrogen. Mr. Gore and other witnesses spoke to the same effect. It was no part of his argument that the old mode of purification described would necessarily convert the subsequent purifiers into sulphide of calcium; but he said that if the gas manufacturer passed his gas at the proper rate of speed through the lime purifiers, that would be the result, and that testing and throwing out at the moment of saturation gave precisely the same results as those aimed at by the plaintiff. Another observation was, that if it be true, as Mr. Heisch said, that wherever carbonic acid predominated over sulphuretted hydrogen in the crude gas, the two gases would pass upwards together, that was destructive of the plaintiff's patent, because the sulphuretted hydrogen and the carbonic acid passed together. Then the carbonic acid would be coming forward in the subsequent purifiers before the sulphuretted hydrogen had been expelled from the first purifiers, and they would never get sulphuretted hydrogen into the second purifier, or get it only concurrently with the carbonic acid for the purpose of converting the subsequent purifiers into sulphide of calcium. The fatal objection to the plaintiff's specification was this. His lordship would remember that Sir H. James, in the cross-examination of the plaintiff, put the question to him, whether he considered it an essential and distinctive feature of his patent that the process should be worked in two series. That was, working the first two for carbonic acid, and putting another series which should interchange between themselves, and not interchange relatively to the two or more carbonic purifiers, and the plaintiff said he considered that a distinctive feature of his patent. He (the learned counsel) maintained that no description of that mode of working could be found, either in the original or complete specification. Giving the plaintiff the utmost credit to which he was entitled, at most it was suggested as a possible alternative. There was a very remarkable statement contained in the plaintiff's affidavit in reply—viz., that in Dr. Letheby's report on the sulphur purification at Beckton there was no mention or indication of any process similar to his, and no allusion made to the essential, and one of the distinctive features of the process—namely, the employment of the purifiers in two separate series. The same thing was also stated by Mr. Gore, so that it appeared the essential and distinctive feature of the plaintiff's process was the division of the process into two separate and distinct series, working the purifiers in two series; one took out carbonic acid, and the second began with the entrance of the gas into vessels from which carbonic acid had been excluded. The plaintiff did not say that was an alternative mode, but that it was the essential and distinctive feature of the invention. The affidavit of the plaintiff, in which that statement was made, having been given in reply, of course, the defendants had no opportunity of stating their views upon it. The plaintiff, when cross-examined upon the point, stated that he used the word "series" in the singular, and that it was an essential and distinctive feature of his process to use two separate series of purifiers; and that sec. 1, p. 6, showed that was so. But the remarkable thing about that was, that the essential feature was not in the provisional specification, nor in the complete specification, unless it was an alternative not in the bill or amended bill, but was only brought forward by the plaintiff in the affidavit in reply, when he found himself pressed. If they were employed in one series, that was the manner pointed out by Dr. Redwood and others—viz., if they had three purifiers when the first was spent, it was thrown out of action, and the second one brought forward, and then the third; but working the purifiers in two sets or series, no purifier in the second set ever became the first purifier in the first set; or, to express it more accurately, the purifiers were in each set interchanged relatively to each other. At Beckton, when Mr. Trewby had four purifiers at work, he was working in two sets or series, and the two last purifiers—the sulphur purifiers—never became the carbonate purifiers until they were used for that purpose. He could not find pointed out in the plaintiff's specification that it should be used in two sets or series, and that the first series should be employed alone for taking out carbonic acid. The description in sec. 1, page 6, was exclusively a working in one series. It was possible he intended by the words in the later specification to include the mode of working which he considered essential, because he put an alternative; but if that were so, he should submit, having regard to the plaintiff's evidence in reply, and his evidence on cross-examination, that the specification would be equally misleading and bad by reason of his not having pointed out the essential feature. If he had pointed out the alternative form, the case of *Simpson v. Halladay* was an exact authority upon the point against the plaintiff. If his lordship came to the conclusion that the essential and distinctive feature was not sufficiently pointed out and specified in the specification, then he should ask his lordship to hold, on the authority of *Simpson v. Halladay*, that the plaintiff had not complied with the condition of his letters patent—namely, to completely describe the invention and the mode in which it should be carried into effect. The plaintiff described a process by which the purifiers were worked in one series only, and, therefore, no one could thence infer that it was necessary to work them in two series. He did not see, nor did he believe there was, any answer to that part of the case. If there were other points in the specification, or in the evidence bearing on the specification, which he had not dealt with, it was not because he did not attach importance to them, but because he considered they had been dealt with by his learned friends who were with him. With regard to the fifth head, it would be remembered the plaintiff claimed the employment of sulphur in a fine state of division in conjunction with an inert substance which would form a porous material, through which the gas might pass freely; but the defendants answer was that that was not novel—that they did not intend to use it; and in support of the plea of want of utility they had the evidence of Mr. Evans. No answer had been given by the plaintiff to that evidence. Mr. Evans had not been asked a single question upon the subject; and, therefore, he asked his lordship to hold that the defendants had proved that the fifth head of the patent was not useful, because it was unworkable. When the plaintiff was cross-examined upon the point, he admitted that oxide of iron, when revivified, contained sulphur, in the language of his patent, in a fine state of division; he also admitted that oxide of iron was an inert substance, forming a porous material through which the gas might pass freely; and that oxide of iron which had been revivified, and used over and over again in that state, would not, as a matter of practice, although it would in theory, take out the bisulphide of carbon. Therefore the question whether oxide of iron, containing sulphur in a fine state of division, was an inert substance within the meaning of the fifth head was simply whether, according to th true construction of that head, "inert" meant absolutely inert, or, as he submitted it did, inert relatively to what they were talking about—namely, the extraction of bisulphide of carbon. It being proved, out of the plaintiff's own mouth, that oxide of iron was an inert substance for that purpose, that it was a porous material, and the only suggestion on the other side being that the patent would not work when used with oxide of iron, he maintained the defendants had proved that the fifth head of the patent was useless in both the legal and practical sense, and that, therefore, the patent was void. If the fifth head of the patent had been worth anything at all, then the mode of purification in use at Beckton, of placing the oxide of iron before the lime purifier, would have been the most perfect purification in the world, for the great virtue of oxide of iron consisted in its extreme economy, it being capable of being used over and over again. No doubt, scientific witnesses and practical gas manufacturers giving evidence, when they were referring to the oxide of iron process, did not think it necessary to explain what that process was. The process was referred to by the plaintiff's witnesses and the defendants witnesses as a thing perfectly well known; and it was perfectly well known to every person engaged in the case, whether as counsel, witnesses, or judge.

The VICE-CHANCELLOR said he thought they ought to know it by this time.

Mr. DAVEY was quite sure of that. The oxide of iron, as Mr. Patterson stated, was exposed to the atmosphere, the sulphuretted hydrogen was taken out and went off in the form of vapour, leaving the sulphur in a free state. The great merit of Mr. Evans's invention was, that it enabled it to be used over and over again, until at last the sulphur deposited accumulated to such an extent, that it was not worth while to use it any more. Even if his lordship

(which he did not anticipate) should take an adverse view to the defendants on the earlier parts of the patent, on the fifth head they had succeeded in showing, out of the mouth of the plaintiff himself, that it was practically useless. The plaintiff, in reply to Mr. Evans's affidavit, had not produced a single witness who had said he had treated it in a gas manufactory, or in an experimental manner; and he asked the court to hold that that head of the patent was proved to be absolutely valueless for the purpose of purification of coal gas from sulphur. It now only remained for him to thank his lordship for the patient hearing he had given him, and to leave the case in his lordship's hands.

Mr. STIRLING, on the same side, said he would not trouble the court with any observations.

Mr. KAY then rose to reply upon the whole case, and said that his task was made considerably more easy by one or two facts. One was, that his learned friends did not appear to be entirely agreed amongst themselves. In the first place he would deal with two points, upon which he would say a few words; because it seemed to him that one, at least, of them did not make much impression upon his lordship, and the answer to both was perfectly easy. The first point was chiefly insisted upon by Mr. Southgate, and as to which a few words were said by Sir Henry James—that was, the conduct of the plaintiff in taking out the patent. Mr. Southgate worked himself up to such a pitch of indignation, that at last he said it was a fraud. But suppose the utmost he could say about it were true, it would be quite a sufficient answer to say this was a suit to restrain the infringement of an existing patent. In that suit, no matter how the patent was obtained, if valid, the plaintiff was entitled to relief. If there was any reason why, the patent being valid, it should be recalled, there was a process specially adapted to that by *scire facias*. No case had been cited, and he never heard of a case in which a patent had been recalled because it had been obtained by a man whose invention was stimulated by the fact that he obtained knowledge in an official position. He submitted that even if a proceeding were taken by *scire facias*, it was not possible upon that ground to recall the patent. But as it was a question of conduct, and as he had a still more conclusive answer, he desired to give it.

The VICE-CHANCELLOR remarked that the point was raised by the answer, and the plaintiff was not taken by surprise.

Mr. KAY said no doubt the argument was put upon the ground that Mr. Patterson was an officer of the Government, and, being so, his duty was to invent, if he could, better processes of purifying gas, and communicate them to the gas companies. He met that by a direct negative. Mr. Patterson was appointed under the Act of 1868, which showed that the object was to prescribe the mode of testing, to ascertain the means adopted by the companies for purifying the gas and prevent nuisance, and to fix a maximum of impurity at which the companies should supply gas to the public. With that the duties of the gas referees ceased. Was it not for the advantage of the gas companies themselves that people should invent new processes of purifying gas? Assume that Mr. Patterson, a gas referee, was the first person to discover a new and valuable process of gas purification, and that he took out a patent for it, was that an injury to the gas companies? It was a great advantage. They need not use it unless they liked. But if they had to use it, paying to the referee a royalty for it, were they injured or greatly advantaged? Surely at last it was recognized that invention was one of the rarest faculties of the human mind. You might present to one hundred men the same set of facts over and over again, from generation to generation, and you would not find the man who would generalize from those facts, and ascertain the law. Was not that illustrated by the simplest case, a thing put to all in their school days—the invention, let him say, of gravitation. How was it that up to the time of Sir Isaac Newton nobody had ever found out gravitation? The same thing had existed since the creation of the world. Was it not the law that the product of a man's invention was his own property? Whoever heard it said that because a man who had the faculty of invention, and who discovered a useful and new invention, the facts having been communicated, let them suppose, under the seal of secrecy, if there were the seal of secrecy implied in his holding a paid office, that the product of invention was less his own property for that? Whose property was it? The property of the gas companies? He was not the servant of the gas companies, but an officer appointed by the Government. He hoped it was the last time it would ever be asserted that a man's invention was the less his own because the facts which led to that invention had been communicated to him whilst he held a salaried office. He held in his hand a patent taken out by Mr. Vernon Harcourt, one of the gas referees, in conjunction with Mr. Fison, for which patent the Government had actually given him £1000 to experiment with. That was taken out in 1873, sealed the 6th of February, 1874, and, at the time of taking out that patent, Mr. Vernon Harcourt was one of the gas referees. Another ground of objection was that it was said the patent was bad, because claims 3, 4, and 5, or some of them, were invalid; and several cases were cited to prove that, which nobody would deny—namely, that if a patent included a claim which was bad, the whole patent was bad. He admitted the law, but he denied that, in the present case, there was any proof of the invalidity of the patent. The Act of the 15th and 16th Vict., c. 83, sec. 41, provided that, in any action or case for the infringement of letters patent, the plaintiff should deliver his declaration, with particulars of the breaches; and the defendant, on pleading thereto, should deliver with his pleas particulars of any objections upon which he meant to rely at the trial, in support of the suggestions of the defendant; and no evidence should be allowed to be given in support of any objection impeaching the validity of such letters patent, which should not be contained in the particulars delivered, provided always that the place or places at or in which, and in what manner, the invention was alleged to have been used or published, prior to the date of the letters patent, should be contained in such particulars. *Finnigan v. James*, 19th Equity, settled that matter. That was the practice prescribed by the Act of Parliament. Had there been, in any pleadings or other document in the present case, any particulars of objections to claims 3, 4, and 5? He maintained that there was no denial of the validity of the patent, as raised as a matter of pleading. He might leave the case there, but he would not. He would ask, had the defendants shown any prior user of 3, 4, and 5? The onus of proof was upon them, and upon this point he would refer the court to Mr. Coryton's book on "Patents," p. 293. Not having done that which was required of them, and the court not being at liberty to receive any evidence upon the subject, by the terms of the Act of Parliament, it would be necessary to see what the defendants wanted to put in as evidence. Not an instance with time and place of prior user, but a paragraph in Mr. Evans's affidavit that there was not, at the date of the patent, any novelty in any of the processes described under the heads 3, 4, and 5 of the invention, such processes being well known to gas engineers, who had used them, as he said, in the purification of gas, but they had long been abandoned. Where and when? Time and place were to be given in the particulars, and proved. The object of the Act of Parliament was that the man whose patent was impeached should, before he came to the trial, have the opportunity of investigating the particular time, place, and manner in which it was alleged his invention had been anticipated, so that he might not be taken by surprise, but have an opportunity of answering, and show, if he could, that there was no such anticipation. But how could the plaintiff answer the general statement of Mr. Evans. It was clearly impossible, unless he could call every gas engineer who ever existed, and get them to deny the statement. He could not, because there was no evidence at all, seeing that it was only information and belief. Thus the defendants were completely out of court upon claims 3, 4, and 5. It was sought to carry the evidence a little further by saying that, having got the plaintiff into the box, and being cross-examined, he said he did not think much of No. 4. But could any one say he would destroy a patent, because, having got the patentee into the witness box, he extracted from him an admission of that kind. In fact, what the plaintiff said was, that of the two processes, he liked one better than the other. Again it was said the plaintiff admitted that potash was too expensive. How could that invalidate a patent? Potash might be too expensive to-day, but it might become cheaper next week. The only other of the claims upon which more was said, was claim 5, upon which Mr. Davey reiterated the argument of Mr. Southgate. If he (the learned counsel) did not misunderstand that argument, it was that the fifth process had been anticipated, that it was not novel because it was the use of sulphides in a finely divided state mixed with some soluble porous material. It was said that had been done long ago, because in revivifying oxide of iron, it happened that sulphur was deposited amongst the oxide of iron in a finely divided state, and that when the oxide of iron was used again, it was used with sulphur in a finely divided state. That was said to be an anticipation. But the answer was, oxide of iron was only used for taking out sulphuretted hydrogen and not bisulphide of carbon. The most conclusive answer however was, that Mr. Patterson, in his patent, described distinctly the sort of material with which it was to be mixed, because he said it was to be "used along with sawdust or such like substance." Supposing there were anything in the argument, where was the particular of objection or pleading which led to it? There was none; and was it to be said that a patent was to be invalidated by the cross-examination of the plaintiff upon a subject of which he had no notice, and as to which he was positively prevented from putting in any evidence.

Mr. SOUTHGATE said Mr. Kay had not read the part of the Act of Parliament which required particulars of objection to the utility of the invention to be given.

Mr. KAY replied that Mr. Davey said it was proved that the fifth claim was not useful. As to that, he (the learned counsel) maintained there was not a tittle of evidence.

Sir HENRY JAMES said the plaintiff not only said oxide of iron was suitable to form the porous material, but he said he did form it.

Mr. KAY: The plaintiff said a mixture of sulphur and oxide of iron was not useful for the purpose, and that he found a mixture of sulphur and sawdust took out the bisulphide of carbon. The one did and the other did not. By experiment, he found that a totally inert material mixed with sulphur would take out the bisulphide of carbon, that oxide of iron mixed with sulphur would not, and therefore he described in his patent sawdust, or other such like material, to take out the bisulphide of carbon; and in the claim, at the end, he said a suitable material to form a porous substance to take out the bisulphide of carbon. There was not a tittle of evidence to show that sulphur mixed with sawdust would not have the effect, or mixed with other like substance would not, or that the oxide of iron was a soluble porous material to mix with sulphur to produce that effect. On the contrary, the evidence was that oxide of iron was not a soluble material mixed with bisulphide of carbon to produce that effect. But if it had been made out that that was an anticipation, the defendants had given no particulars of it; and, as to the utility, all he could say was, that if he had given no sufficient answer he did not understand what an answer to an argument was. The main parts of the case he would deal with in this order. Certain objections had been made to the plaintiff's patent itself, upon the face of it. Then he would take the different instances of anticipations, including Mr. Mann's patent. First of all to deal with the plaintiff's patent. As he had said in his opening, the office of a claim had been long since established to be not to enlarge the subject of a patent, but to restrict it, and for that purpose he referred to the well-known case of *Kay v. Marshall*. Another thing on the face of the patent, which was striking at the first glance, was that it was separated into different divisions. It began first of all by saying to what the patent related. That he understood to be the subject to which the patent related in the different parts of it. The paragraphs referred in the same order and separately to the five portions of the patent mentioned afterwards. The first to the use of sulphide of calcium, the second to the means of producing sulphide of calcium, and the third, fourth, and fifth to the claims which he had already dealt with. It was beyond all question, that nothing was more natural or reasonable than to apply each of the claims to the particular division in the body of the patent which corresponded with it, and all the claims were preceded by a preface in exactly the very same words as were used in *Arnold v. Bradbury*, where a preface in those words was held to be that the claim was a claim to a process as described. The first part of the patent was a claim to a process simply, and what follows was a caution to infringers. It was not, as had been argued, a claim to a principle. Was there any evidence that the process described by the plaintiff had even been used before the date of the patent? He denied that before the date of the patent there had been used in gas manufacture, in separate purifiers, pure sulphide of calcium, as distinguished from foul lime, and that, to that pure sulphide of calcium, the gas had been submitted for its operation after being freed as much as possible from carbonic acid and sulphuretted hydrogen. That was the first process described. The second head was a new principle and process of employing lime purifiers. But there was not a word about "principle" in the first, and the patentee showed that where he meant to claim principle he knew perfectly well how to do it. The two processes under that principle were given, the short result being to use the first purifier or purifiers of the series for taking out wholly, if it were possible, carbonic acid, so that sulphuretted hydrogen would go forward into the subsequent purifier or purifiers, converting the lime in those, not into gas or foul lime, but into pure sulphide of calcium, used under the first process in separate purifiers, for the purpose of taking out the sulphocarbons. The claim was a method or system of employing new purifiers in the manner described. There was only one way of doing it after all. Dr. Odling had said that, whether you converted the lime into carbonate of lime or into sulphide of calcium in the first purifier, which was whether you wholly took out the carbonic acid by the first purifier or purifiers, depended upon the speed at which the foul gas was allowed to pass through it with relation to the amount of lime in it. If you allowed the gas to pass too quickly, you would not, by your first purifier or purifiers, arrest the carbonic acid, but both carbonic acid and sulphuretted hydrogen would go over, the gas would flow by without being deprived of either, and certainly not of the carbonic acid. The whole thing would fail if the carbonic acid were allowed to go forward. Dr. Letheby said that, by testing for sulphuretted hydrogen, you might be quite certain that carbonic acid was not coming off. No doubt that was so if the speed was so regulated that the lime would take up every portion of the carbonic acid.

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Mr. KAY continued his reply. He said he had pointed out to the court that the final subject of the specification was not a principle, but a process for using sulphide as distinquished from gas lime in separate purifiers and presenting the gas to it after it had been, to as great an extent as possible, purified from carbonic acid and sulphuretted hydrogen, in order that, by so doing, you might, in such separate sulphuretted hydrogen purifiers take out the sulphur compounds. He had also reminded his lordship that the description of that process was not enlarged by the claim, and that there was a great distinction in the second head of the patent which described not only a process but a principle, claiming the one, and the other, and giving alternative methods. One alternative was by treating all the vessels as one series, using the first two to take out carbonic acid, and the second was to use them in two series, never allowing one and two to become three and four, using three and four to take out sulphocarbons, and never allowing them to become one and two. It was

in cross-examination put to the plaintiff where he described two series. Mr. Patterson said he did not care what they were called, whether two series, or two sets, but he described that of the series, the first vessels should be used exclusively for taking out carbonic acid. That his process was a process by which in one series if that were the right word to use, two operations were performed, so that in truth two series were made. The rotation was a rotation of the first two vessels of the series, and the other two were made to rotate for a different purpose, so that in fact there were two rotations in the series. But either plan could be effective to take out carbonic acid first, and then the later vessels of the series would take out sulphocarbons. Was the principle of taking out carbonic acid first, so as entirely to use the sulphuretted hydrogen for the purpose of making and maintaining sulphide of calcium in the later vessels, new as a principle? He maintained it was. He contended that until the referees report was published, and until Dr. Odling published his letter that was a new principle in gas purification. The principle of working lime purifiers which was the thing to which it was confined, by using the earlier vessels of the series, or sets, or whatever they were called, for the purpose of taking out carbonic acid wholly in order that the sulphuretted hydrogen left in the gas might convert the lime in subsequent vessels into pure sulphide of calcium, which was to be used under the first process for taking out sulphocarbon, was new as a principle, as well as a process at the date of the plaintiff's patent. He did not think there would be much difference between his learned friends and himself, as to the law applicable to a patent claiming a principle. It was quite settled that a bare principle could not be the subject of a patent at all. For that reference was made to Mr. Agnew's book on the "Law and Practice of Patents," page 42. He hoped to have satisfied his lordship that under the first head Mr. Patterson very carefully abstained from claiming any principle, but, with design and care he claimed the principle under the second, which principle, in no shape or way, was known before his patent was taken out. The patent consisted of a three-fold process. The second head would come first in the process of working, but the threefold process was shortly this. First, take out carbonic acid as a separate operation, by means of the first lime purifier or purifiers. That was new in principle and process. The object of it was that in the subsequent lime purifiers of the series you would have the lime turned into pure sulphide of calcium as distinguished from gas lime; that was, they would contain no carbonic acid. Moreover, as the plaintiff explained, by that process you drove forward as much sulphuretted hydrogen as possible. Therefore, you utilized as much sulphuretted hydrogen as possible. So much for process No. 1. Process No. 2 was, that in the subsequent purifiers you produced and maintained sulphide of calcium. The third was, that the effect and object were, that in the subsequent purifiers you would, by the operation of the sulphide of calcium, take out the sulphocarbons in the best possible manner. Then came the question, were the process described under the first head, and the principle and process described under the second head, new or not at the date of the patent? Was the process of employing lime in a state of pure sulphide of calcium, as distinguished from gas lime, for taking out sulphocarbons as described, new? That question might be put thus: Had there ever been any process at the date of the patent of this kind? Fill, by any means, a separate purifier or purifiers with pure sulphide of calcium as distinct from gas lime, which was sulphide of calcium containing little or no carbonic acid, and submit the gas to its action after having deprived the gas first of all of its carbonic acid and sulphuretted hydrogen. All those things were essential. The purifier must be a separate purifier, containing nothing but sulphide of calcium. The gas must be submitted to its action after being deprived, as far as possible, of carbonic acid and sulphuretted hydrogen, there being no impurities at all left in the gas for them to act upon, but the sulphocarbons The question, therefore, was, was that process of so applying pure sulphide of calcium in separate purifiers to the gas in a particular state for the purpose of taking out sulphocarbons, new at that date? He would remind the court of a passage taken from a statement of Mr. Trewby in 1871, who, speaking of certain experiments made at Bow, said, from those and other experiments, and observations previously made by him, he felt convinced that he should be able, upon a working scale, greatly to reduce the sulphur if he could keep certain purifiers in a state of sulphide, or nearly so. Then as to the alleged anticipations. First of all it was said the patent, as to the lime process, was anticipated by what was done at Bow. Then if that were not an anticipation, there was an anticipation in what was done at Beckton. Then if Bow and Beckton were not enough, Mann's patent was an anticipation. To deal with what took place at Bow. Was the process of purifying the gas from sulphocarbons, by taking out those sulphocarbons by the agency of pure sulphide of calcium in separate purifiers, presenting the gas to its action without any carbonic acid or sulphuretted hydrogen in it, practised at Bow? Was the principle of taking out carbonic acid first, by a separate operation, in order to produce and maintain sulphide of calcium in the subsequent purifiers, known as a principle at Bow, and was it as a principle brought into action? If it were, of course the patent was bad. He was indebted to his learned friends for introducing certain new evidence, consisting of letters contained in a parliamentary paper which he had not seen. One was a letter of the 31st of December, 1869, by the secretary of the gas referees to the Board of Trade, relating to the gas of the defendant company, the amount of sulphur in that gas, and the question of the maximum for sulphur. It said that the result of the testing fully justified the anticipation of the referees, especially by revealing the great fluctuations from day to day which took place in the amount of sulphur in the gas. These fluctuations had now ceased. The Great Central Company's fluctuations in September, 1869, varied thus—37·02 per 100 cubic feet, 25·83, 17·99, 23·75, 16·78, 24·95, the average being about the maximum. That was, according to the defendant's evidence, two years after the process which they said they were now using had been used at Bow. They exceeded the maximum on every day there recorded except two, and on neither of those two days did they get lower than 16·78. The City Company was not so bad. The highest was 22·4, lowest 14·0, average being 16. Arundel Street was above; Leadenhall Street was below. But Bow was the worst of the three in September, 1869. He believed the City was supplied from Blackfriars, which did not at that time use lime at all. On the 14th of January, the referees wrote to the Board of Trade, and Mr. Evans, one of the referees, concurred in the statement sent, indignantly repelling the charge of partiality which had been brought against them, because Mr. Evans was one of their number. There was a clear statement that, according to the tests in use, the fluctuations at Bow were so great that it was impossible to use the maximum of 20 grains per 100 cubic feet, and the instance of Bow was given as one of the reasons why it should not be done. He would call attention to Dr. Letheby's affidavit, in which it was stated that in 1870 he described, at a meeting of the Association of Gas Managers, the process then in use at the Great Central works—namely, the Bow Common works of the defendant company, which description was published in the JOURNAL OF GAS LIGHTING for that year. Dr. Letheby described the process to be that the lime was purposely left in the two purifiers until it had become foul, and a good deal of the sulphuretted hydrogen first absorbed was displaced by carbonic acid. The result would be that in the first purifiers it would be wholly displaced, and in the second it would be, according to Dr. Letheby, almost wholly displaced. The first purifier would contain carbonic acid, and the second would contain hardly any sulphide of calcium, and that in a diminishing quantity. Was that using sulphide of calcium in a separate purifier for the purpose of taking out bisulphide of carbon and presenting the gas to its action after being deprived of carbonic acid and sulphuretted hydrogen? It failed in every point. In the first place neither of the purifiers would contain pure sulphide of calcium, as distinguished from gas lime. In the second place the gas presented to the action of such sulphide of calcium, as it did contain, would not be purified from the carbonic acid and the sulphuretted hydrogen, for sulphuretted hydrogen would have been coming over for a length of time. Was carbonic acid taken out as a separate operation, and then the sulphuretted hydrogen allowed to flow into a clean lime purifier, into which no carbonic acid had got? Quite the contrary, because the foul gas went through both purifiers till nearly all the sulphuretted hydrogen was discharged from both. The effect of that would be to convert the first wholly into carbonate of lime, and the second almost wholly into carbonate of lime. The meaning of Dr. Letheby's statement was that the best way of performing the operation of sulphide of calcium was to leave the lime in the purifier in which it was to be used, till the carbonic acid had driven out most of the sulphuretted hydrogen. At this day would anybody say that. It was now known that, if carbonic acid drove the sulphuretted hydrogen out of the purifier, and to that extent destroyed the sulphide of calcium, it made carbonate of lime, which was perfectly inert upon the sulphur compounds. Therefore, it was the very worst plan which could be used to enable the sulphide of calcium to operate upon bisulphide of carbon to drive the sulphuretted hydrogen out of the purifier, and convert the sulphide of calcium into carbonate of lime. It was clearly not the process described by the plaintiff, that the lime which was intended to take out the sulphur compounds should be turned from a state of sulphide of calcium into carbonate of lime, in order to take out sulphur compounds. It was exactly the thing the plaintiff said ought not to be done. He said, "Take sulphide of calcium, and take care that, in using it, you deprive the gas of its carbonic acid." Dr. Letheby said, so far from doing that at Bow, they designedly did exactly the contrary; for, instead of preventing the gas having carbonic acid in it when it was exposed to the action of sulphide of calcium, he recommended that the raw gas containing carbonic acid should be passed through the purifier containing sulphide of calcium, until it had largely altered the nature of the sulphide of calcium into carbonate of lime. So that, so far from it being an anticipation of the plaintiff's patent, it was a statement that what took place at Bow was diametrically opposed to every part of the patent, both to the first process described, and to the principle of the second process. The principle was that, in order to maintain the sulphide of calcium as long as you could, you must take out carbonic acid by a separate operation, first of all. Dr. Letheby said that that was not to be done at all, but pass the carbonic acid into the sulphide of calcium, and that was the best way of taking out the sulphocarbons. In cross-examination, Dr. Letheby carried that down to 1871, showing that the process at Bow was diametrically opposed to that which the plaintiff claimed. It was said by the defendants counsel that the invention claimed was to be the use of sulphide of calcium as a purifier. The plaintiff never claimed that at all, but only in separate purifiers, with gas prepared to be acted upon by it, which was a very different thing altogether, and that was only claimed as a process. Then Dr. Letheby referred to a number of books, in which he said the fact that sulphide of calcium would act upon bisulphide of carbon was a chemical fact very well known. He (the learned counsel), in opening, had said it was not material to his case to deny the chemical fact, that sulphide of calcium would act upon bisulphide of carbon, was known. The fact that a spark of electricity could be communicated through a thousand miles of wire with scarcely a moment's pause was known very long before the invention of the electric telegraph, and many a mind had been directed to applying that principle of natural physics to the operation of telegraphy, but that did not prevent a perfectly good patent being taken out. Any man might apply any natural principle whatever to a use in manufacture or art, and obtain for that application a perfectly good patent, though the principle might be as old as the principle of telegraphy, the principle of gravitation, or any other. But did the books referred to in any clear way enunciate the principle—which books were not referred to by any of the defendants counsel? He would take Gmelin's "Handbook of Chemistry," which was a book written for the use of tyros, and might, therefore, be taken to be very precise and diffuse. But he found it did not bear out the statement which Dr. Letheby had made. He did not think it could be gathered from pages 204 and 205, that bisulphide of carbon could be acted upon by sulphide of calcium. Although a learned chemist, from the depths of his great knowledge, might deduce that it would have an effect upon bisulphide of calcium, nobody else would; and how could that be treated as an anticipation of the principle, that sulphide of calcium was a good thing to use practically in gas manufacture, for the purpose of taking out bisulphide of carbon? It was not known, as far as the books went, that sulphide of calcium was even an agent at all for taking out even bisulphide of carbon, much less for taking out the other sulphur compounds, the form of which could not be determined. He had shown, from the evidence of the defendants principal witnesses, the exact process in use at Bow down to the year 1871. Mr. Harris's statement was identical with that of Dr. Letheby. He said he used two purifiers; he used them long after the sulphuretted hydrogen came forward from the second and until a large part of the sulphuretted hydrogen had been displaced by carbonic acid, and then, when that happened, he substituted a clean lime purifier for the first one. So that he carried the history on from 1867 to 1871. Each and every one of the witnesses said the only test was for sulphur, and after the second purifier. Dr. Odling said the lime was used in the purifiers before the oxide of iron, and the lime, instead of being turned out when it began to show sulphuretted hydrogen, was kept in for a considerable time after, and long after it became foul, and was only turned out when the gas was found to be getting too impure. That was essentially different from what he recommended in his lecture in 1872. No process similar to that recommended in his lecture was carried on at Bow up to the date of the lecture. The principle employed there, whether knowingly or not, was exactly similar to that of which he availed himself; but the mode of carrying it out was different. Two lime purifiers were used at Bow, and the sulphur test was not used till the gas was on its course to the gasholders, or afterwards, he could not say which. So that the test would be after the oxide of iron purifier, and not between the two lime purifiers. All the witnesses agreed in saying that the lime was kept in the two lime purifiers, not only till sulphuretted hydrogen came off, but for a long time afterwards, and until such sulphide of calcium as was formed in them was broken up, to a large extent, by carbonic acid. If that were so, it was essentially different from the plaintiff's process, which was the process recommended by Dr. Odling, in his lecture in 1872. Not one of his learned friends had attempted to deal with Dr. Odling's evidence; and Mr. Southgate, having dealt with everything he thought material, said he should not make any remarks upon Dr. Odling's evidence, that he left the box as he came into it. The practice at Bow, down to the time when the patent was taken out, was beyond all question entirely different from anything described in the plaintiff's patent.

The VICE-CHANCELLOR said Bow was alleged against the plaintiff on the ground of user.

Mr. KAY replied that Bow was the case in which the process was said to have been chiefly anticipated. Then what was the principle employed at Bow? It was certainly not the principle of extracting carbonic acid by a separate operation; but it was the using in some shape or other, sulphide of calcium. Therefore, the process was not the same, and the part of the patent which described the principle—viz., taking out carbonic acid by a separate operation—was not in use at all. It would be important to observe the dates. On the 9th of March, 1872, the patent was taken out, and on the 26th of March, the report, which gave an outline of the patented process, was sent to the officers of the different gas companies. Bearing those dates in mind, he would turn to what Mr. Harris stated to be the operation at Bow. After stating that he was quite unable to account for the excessive amount of sulphur, he said he made a slight change in 1872 by slaking the lime; about that time they commenced using more lime. They changed the purifiers more frequently. The increase of lime was about

50 per cent. He should show that the increase was infinitely more than 50 per cent.; but whatever the amount, it was beyond all question that the change took place about the month of March, 1872. But the matter did not rest there; for on the 30th of May Mr. Harris stated he had no control over the fluctuations of the gas, and on cross-examination he adhered to that statement. But now they knew the way to do it; they were able to keep within the maximum; and the variation which previously occurred was entirely got rid of. The plaintiff stated that by his process you could calculate upon definite results, and that after the testings for sulphur and carbonic acid had been made for a short time, the engineer would be able to ascertain the right mode of working his lime purifiers with sufficient accuracy by simply noting the quantity of gas passing from the purifier after determining from how many million feet of gas the first lime purifier was capable of taking out the carbonic acid, the testings might be dropped if the speed were properly regulated. But, without testing, you could not determine, unless the speed was right, what quantity of gas the lime in the purifier would free from carbonic acid; but when once the rate of speed was determined, you could tell how long the purifier would act to take out carbonic acid, and the quantity of gas passing through would tell whether or not there was carbonic acid in the gas. The law once settled, was not subject to variation—it remained the same. When was the law determined at Bow? Before the date of the plaintiff's patent or after? The evidence proved beyond question that it was not till after the date of the patent. They had it clearly proved that till after the date of the patent, carbonic acid was allowed to pass over from the first purifier into the second, and he would demonstrate the matter so clearly, that there should be no getting out of it. Mr. Carpenter stated that they were above the maximum now, though they had not improved their purification; the purification might be the same, but their knowledge might be more firm on the subject than it was in 1867. Two dry lime purifiers were in work at the same time; he did not know how often the lime was changed. Three and a half million cubic feet of gas having passed through the first purifier, it was taken away, and the second made the first, and seven millions altogether passed through that before it was changed. He did not test for carbonic acid as a regular thing, though he did for sulphur compounds. According to that statement, he must have tested to know how much lime in the purifier would take out the carbonic acid, and, therefore, they were doing precisely that which the patent recommended. But he would carry it further, and see what was the amount of lime used, and the change that was made at Bow. The quantity of gas made there per day was 2½ million cubic feet, and if that were divided by 24, the hours of working, it would give 104,112 cubic feet per hour. According to that, each purifier would be taken away in about 60 hours. The report stated that the make of gas at Bow in 1871 was 120,000 feet per hour, which would necessitate the purifiers being changed every 52 hours; but how often were they changed in 1871? It appeared that in October and November, 1871, the average time of keeping the purifier in action was 168 hours, or more than three times as long as it would take to pass 7 million cubic feet of gas through it; it would let through 21 millions instead of 7 millions. The effect of that was to show that the increase of lime was not 50 per cent. as stated, but that three times as much lime was used now as in 1871; therefore it was not surprising that the results at Bow were what they now were. Mr. Carpenter stated he changed the purifiers about every 30 hours, and that was exactly the deduction they had just arrived at. Not only had he proved that down to the date of the patent there was no process in operation at Bow, which in any way resembled the process described in the patent, but he got this most clenching fact, that after the publication of the referees report, describing the mode of working lime purifiers, they immediately increased at Bow the quantity of lime to three times the quantity it had been previously, and instead of keeping the lime purifiers at work for 168 hours, they only kept them at work about 60 hours. On this state of the evidence, what was the result? His learned friends had said that it was quite true that at Bow no one knowingly adopted the plaintiff's process; still, practically, they used lime, and by that means may have unknowingly used sulphide of calcium.

Mr. SOUTHGATE said what he stated was, that they might have unknowingly adopted the alternative process.

Mr. KAY said he would take it either way. He had the confession of all the defendants witnesses that they had no means of regulating the amount of sulphur impurity, and that, in the then state of knowledge, it would have been ridiculous to fix any maximum; but directly the plaintiff's process was published, all difficulty ceased. Suppose, in the use of malt in brewing, it had been found a certain ingredient was added to the beer which brewers in vain had tried to get rid of, and that a man, who had investigated the chemical action which took place in brewing, discovered a mode of getting rid of the impurity, would it seriously be contended that the process so discovered could not be the subject of a patent, because malt had always been used in brewing? Unless his friend's contention meant that, it meant nothing, because he said a man could not have a patent for purifying gas by lime, as lime had always been used. If that was the law, he thought it was time it was amended. It was as plain a proposition of patent law as could be—that the use of lime in gas purification did not prevent a man from taking out a patent for a particular process of using lime, which process was novel and useful. As to the utility of the invention, no one in his senses could deny it, in the face of the evidence; surely not Mr. Harris, who, as late as the year 1871, protested against a maximum being fixed. He would suppose his friend's argument to be that the time of using the lime was variable, and that for a day or two, by accident, they used their two lime purifiers in such a manner that the first took out all the carbonic acid, and the second was thereby converted into sulphide of calcium, and took out the sulphocarbons. His answer would be, that they had never done so, and the tables which were in evidence supported that statement. But, even if it were so, would that accidental operation, which they did not know to be an anticipation of the patent, have been an anticipation? He could not understand it. The patentee said, "I show you a scientific definite way, by which you may always calculate and regulate with accuracy the amount of sulphocarbons taken out of the gas;" though he (the learned counsel) believed that the patented process would in time be found to take out all the sulphocarbons. Could it be an objection to the patent that the process might have been accidentally used for a day or week in some gas-works? Certainly not; if it was not used knowingly and designedly, it was not used at all. But it was enough for him to say that there was no evidence to show that it was done, for even one hour, at Bow from the time the works were erected till March, 1872. The process in use at Bow was that which was described by Dr. Odling, who stated that, if foul gas were passed into a lime purifier, the operation and effect was to convert immediately both carbonic acid and sulphuretted hydrogen, which mixed with the lime in different proportions; the lower trays would have chiefly carbonic acid, and the upper trays have more of the sulphuretted hydrogen, by reason of carbonic acid having a greater affinity for lime; but in no one tray would there be pure sulphide of calcium. If the process were continued till the sulphuretted hydrogen was nearly all driven off, you got pure carbonate of lime; and the result would be that, in the next purifier, there would be no carbonic acid, if you stopped in time, but nearly pure sulphide of calcium. But, unless the time of using the first purifier were regulated with the greatest care, the same effect would be produced in both; and that was precisely what was done at Bow down to March, 1872. He submitted that it was made out, from the defendants own evidence, that down to March, 1872, there was no application of the plaintiff's process for a single day or hour. Next he would deal with the evidence of Kirkham, Brothers, and Spice, as great reliance had been placed by the defendants upon their testimony. They described various processes, which were practically the same process, as Dr. Letheby said, as that in use at Bow during 1870 and 1871, and which Mr. Harris said went on until he made the change in 1872. Mr. Kirkham said the practice was to use dry lime in a set of four purifiers, three in action and one off; and, on the third vessel showing the merest trace of sulphuretted hydrogen, a purifier of clean lime was put on, and the first one shut off, for the purpose of removing the foul lime. That was the same thing as was done at Bow. Mr. Brothers said that, before 1869, he had used nothing but lime for taking sulphuretted hydrogen out of the gas; he generally used dry lime purifiers, and changed them in succession. When sulphuretted hydrogen was detected at the exit-pipe of the second purifier, the gas was turned off from the first and made to enter the second, which then became the first in the series, and a clean lime purifier was brought into use as the third. In that process the carbonic acid was arrested principally, if not wholly, by the lime in the first purifier. But that was only a deduction he had made from the process, and was not the result of the evidence in the case. No test was applied for carbonic acid, and they did not, as Mr. Carpenter did, ascertain how much gas, in proportion to lime used, could be passed through, so as to take the carbonic acid first; and the operation in use, described by those witnesses, was precisely that in use at Bow in 1870 and 1871, as described by Dr. Letheby. That concluded his remarks with respect to the alleged anticipation at Bow. The next alleged anticipation was the process as used at Beckton. At Beckton there were three sets of purifiers, each containing four purifiers, of which only three were in action at the same time; one in each set being kept out of action, ready to take the place of one of the others. The gas did not pass through all three, but half passed through No. 1 set and half through No. 2 set at the same time; and then all of it passed through No. 3 set. The oxide of iron purifier was used first, showing how vague was the state of knowledge about lime purification when the Beckton works were started. None of his friends had alluded to the process used by Mr. Trewby in October, 1871, as an anticipation. Mr. Trewby, instead of using three oxide of iron purifiers, made the first of the set a lime purifier, so that each part of the gas having passed through three lime purifiers, after the stream was united, it was made to pass through one more lime purifier, and the effect was for about two days to lower the amount of impurity to 16 grains. Mr. Trewby had to give that process up, in consequence, as he stated, of the back pressure becoming too great. Was putting on an additional lime purifier an anticipation of the plaintiff's process? Obviously it was nothing of the kind, but simply an attempt to see whether a better result could not be obtained by the use of more lime. He would now go to what took place on the 18th of February, 1872, which was three days after the letter—that had been so often referred to—of the 15th of February, written by Mr. Patterson to Mr. Trewby in confidence, asking him to try an experiment. Could anybody say that a patentee, who had his patented invention ready, writing that letter to a friend who was in office at a gas-works, and suggesting to him the experiment of taking out carbonic acid first, even if it were done successfully, would be an anticipation to destroy a patent taken out a month afterwards? It would be extraordinary. He had shown the court that the authorities were directly the other way, as decided in *Bentley v. Fleming*. The report stated that the machine was lent to a friend, and worked in a "public room."

Mr. SOUTHGATE said that was inaccurate.

The VICE-CHANCELLOR remarked it was only a room to which workmen had access.

Mr. KAY: That was the case with regard to the defendants works. Could it be said that what Mr. Trewby did at Beckton was not done in consequence of the letter of the 15th of February? First of all, Mr. Trewby did not say it was not. He said that on Feb. 18 he commenced "quite a new plan," and he said his test for that was not perfect. He did not say anywhere that that which was done three days after the letter of the 15th was not done in consequence of the suggestion in that letter. The letter being set out in the amended bill, neither in the answer nor in the evidence, nor anywhere, did Mr. Trewby deny it. If he had done so, he (the learned counsel) would have found it perfectly impossible to credit the statement. Did the new plan succeed?

Sir HENRY JAMES said Mr. Trewby was asked whether, in carrying the work into operation on the 18th of February, and continuing it, he did that in consequence of anything he had learned from the plaintiff or his patent, and he said, "No."

Mr. KAY: There could be no doubt it was in consequence of the suggestion contained in the letter whether he knew the chemical principles or not. The result was that, after putting the purifiers as described in his letter of the 19th of February, 1872, and finding no improvement effected, on the 29th he tried certain experiments, and then concluded the result arose from a deficient action in the purifiers which he had not suspected, but which he found to be a distortion. The average of grains in February was 48·89 (more than twice the maximum now), and in March, 31·56; the maximum in February was 50·98, and in March, 54·75. There was no success until after the plaintiff's patent was taken out. What was the result of Dr. Letheby's testing for that time at Beckton? The average throughout the month of January, 1872, was 44·86; February, 44·93; and in March, for the first time, there was a change, but even then it was far above the maximum, being 37·98. It was clear, therefore, that what was done did not succeed. Dr. Odling went down to Beckton on Feb. 24, and made a full inspection of the works. Being in the neighbourhood again on the 26th of March, he went there. He, on the first occasion, saw Mr. Trewby, who, he said, explained what he was doing, and gave him an account of the whole of the variations in the mode of lime purification, adding that his recollection went to this, that whatever was being done at that time was not achieving success. Dr. Letheby's letter of the 18th of March gave not only the fact, but the reasons, recommending the lime to be in the purifiers for about 24 hours, instead of four days after the purifier had shown signs of fouling. So that in March, 1872, so far from adopting the plaintiff's process, they were keeping the purifiers full four days after they had shown signs of fouling. On the 8th of March, there was an interview between the plaintiff and Mr. Trewby, at which the plaintiff said Mr. Trewby stated he did not believe sulphide of calcium would remove bisulphide of carbon. Mr. Trewby, so far as he could recollect, stated that Mr. Woodall had informed him that Dr. Letheby told him sulphide of calcium was an adequate purifier from sulphur, but that, having purchased it at a chemist's, he had tried it without success. Mr. Trewby said he did not say he did not believe sulphide of calcium would remove bisulphide of carbon. The state of Mr. Trewby's mind and belief on the 25th of June was the same as to sulphide of calcium as on the 8th of March. That was proved by a letter written by him on that date. On the 8th of March, Mr. Trewby did not believe that sulphide of calcium was an efficient agent for taking out the sulphur compounds, as was shown not only by what he said at the interview, but by all the letters down to the 25th of June, after the referees report had been laid before him. His own knowledge was that, on the 18th of February, three days after receiving the plaintiff's letter, from which he learned nothing, he commenced quite a new plan of working the purifiers, which was to use one or two of them for taking out carbonic acid first. That was the plaintiff's suggestion. The chemical facts were, no doubt, known, but the mode of working was, as Mr. Trewby said, "quite a new plan," which did not succeed, and he did not believe it would succeed. Mr. Trewby said also that what he did in October, 1871, was, that he put on additional lime purifiers, which he could not continue, and stopped on the 19th of November, because it produced so much back pressure.

The VICE-CHANCELLOR said he was under the impression that the back pressure was caused solely by the large quantity of gas which was passed through.

Mr. KAY said the witness stated that two streams had to pass through the one purifier, which added to the pressure tremendously, so that it was obliged to be removed. He was compelled to abandon that until he had the check purifiers

on. Mr. Trewby said those were part of the original plan; but the check purifiers, as originally designed, were on the other side of the gasometer. They were both put at the end of the purifying-house before the gas came in the gasometer; but whether put in one place or the other, how was it possible they could relieve back pressure in preceding purifiers, as Mr. Trewby would have the court to believe? Being put on last of all, how, in the nature of things, could they prevent the back pressure in the purifiers that were before them? In the plaintiff's evidence-in-chief it was shown that the make of gas at Beckton, from Oct. 24 to Nov. 18, 1871, when the back pressure was said to have been occasioned by putting on the lime purifiers, was not only greater than usual, but more than 20 per cent. below the amount of gas which, according to the original design, each house was capable of purifying. What was stated to be the object of the check purifiers? To arrest any escape of sulphuretted hydrogen or ammonia in shifting the centre-valve of the third set. Was it the fact that now the third set was used with lime or not? The statement was positively that he could not use lime in the third purifier in each house till he got his check purifier, because of the back pressure. He got his check purifier on the 12th of May, and he said the process he was now using was not to use the third set with lime at all, but oxide of iron. A more complete demonstration of a fallacious attempt to get out of a difficulty taken from Mr. Trewby's evidence could not be imagined. But it should not be left there; there was another admission made at the last moment in the box, that he was charging the third set in each course with oxide of iron now. The reason he gave for abandoning what he said he was doing—because of the back pressure in using the third series—with sulphide of calcium was a reason which, the moment it was examined, vanished, as far as the check purifiers were concerned; because they could not, by any possibility, relieve the back pressure, and nobody said they did. But the advantage of the check purifiers, in enabling him to charge the third series with lime instead of oxide of iron, was a thing equally fallacious; he no longer did so. In truth, all he did now was to put outside the purifying-houses two lime purifiers, used separately for taking out carbonic acid, testing them every hour to see that no carbonic acid passed them, and then, the purifiers in the house being kept by this process—which was identically Mr. Patterson's—in a state of sulphide of calcium, he found he did not want more than three filled with lime, and he used the rest with oxide of iron. Then it was said, although it could not be denied that the process used in February was not a success until after the date of the patent, it was because there was a distortion of the purifiers; because the gas was too hot, and the condensers were imperfect. What was that to the plaintiff? It failed. In Mr. Trewby's hands, as an experiment, it was not a success. Supposing the experiment, if it had been a success, would have been an anticipation of the plaintiff's patent; not being a success, the value and utility of it not being made out, would Mr. Trewby have gone on with it, if it had not been for the referees published report, and the patent afterwards? There was nothing to show that he would. Suppose a man said he had invented a new process of producing a certain result, and wished a friend to try whether it did so or not, and that friend, after trying, said the man must be wrong because the result was not produced, and he for a while was discouraged, did not take out his patent, and abandoned the use of it; but after a time said, notwithstanding the failure, he would take his patent out, would the patent be bad because of the unsuccessful experiment? The friend, the manufacturer, found the experiment did not succeed, because his machinery was out of order, but could he, therefore, say the experiment was an anticipation of the patent? That was the point of the syllogism, but he did not follow it. Mr. Pearce proved that it was perfectly understood by the referees that the plaintiff was to take out the patent for the discovery, before the issue of the report.

FRIDAY, JAN. 21.

Mr. KAY again resumed his reply, saying he had very nearly finished what he had to advance with regard to the Beckton operations. Sir H. James had said he would show from the records of workings that the defendants counsel were entirely wrong in their theory, that if gas was passed through lime for a certain time till sulphuretted hydrogen came over, it would require only a short time longer before carbonic acid came over. Sir H. James said that the workings at Beckton proved that that was not so. He would remind his lordship of what Mr. Trewby said when he was recalled, which proved that the view taken by the plaintiff's counsel was accurate. Suppose there were a series of purifiers, four in number, and the order in which they were worked was, that carbonic acid was never allowed to pass the first in order. The moment carbonic acid was shown to be in No. 1, it was taken out and a clean purifier put at the end of the series, making No. 2 No. 1, and so on in rotation, making them all No. 1. As each became No. 1, it was for the first time subject to the action of carbonic acid, because carbonic acid, according to the specification, was never allowed to pass the first into 2, 3, and 4, which got nothing but sulphuretted hydrogen, and the other compounds of sulphur. Thus the lime in them became converted into pure sulphide of calcium. And it was obvious that when the purifier was full of pure sulphide of calcium, it would not take long even after it was subjected to the operation of carbonic acid to drive out all the sulphuretted hydrogen and convert the contents of the purifier into carbonate of lime. But if you took one purifier, and subjected it to the action both of carbonic acid and sulphuretted hydrogen, as was done when foul gas was passed into it, then it became, as Dr. Odling and Dr. Letheby described, not merely carbonic acid, but partially sulphide of calcium. If that operation went on in one purifier, you had not to drive out an immense quantity of sulphuretted hydrogen, but only the small portion of sulphuretted hydrogen which was there. Therefore, by continuing to pour foul gas through the purifier which contained three-quarters carbonate of lime and one-quarter sulphuretted hydrogen, it would take a very much shorter time to convert that into carbonate of lime, and make carbonic acid come over, than if it contained nothing but sulphide of calcium, and no carbonate at all to begin with. He would show, from Mr. Trewby, that when at Beckton, a purifier being full, took many days after it became foul to show carbonic acid, it was because no carbonic acid was allowed to get into it till it became No. 1, and when it became No. 1, it took a very short time. It was then full of nothing but sulphide of calcium before the carbonic acid came over, although carbonic acid would have very much more to do than in the other case. That he maintained the records of working at Beckton demonstrated. From the correspondence it appeared that Mr. Phillips was anxious that the referees report should not be sent in, because when it was, the maximum would be fixed, and Mr. Patterson wrote to Mr. Phillips, saying that the report was sent in the previous afternoon, because it could not be kept back any longer. The defendants counsel said that the suggestions in the report were made to Mr. Trewby in a letter before the report was made, but he had it from Mr. Trewby on oath, with that letter before him, that such was not the fact; that no suggestions were made by the plaintiff to him, and particularly as to the carbonic acid being the cause of the failure, denying explicitly and positively that the plaintiff ever told him that. But suppose the letter relied upon had the effect attributed to it, could it be said that that invalidated the patent? Was it attempted to be proved anywhere that Mr. Patterson had explained his process elaborately to Mr. Trewby? Suppose he had tried to get Mr. Trewby, from time to time, to experiment on various parts of his process, would that be a communication amounting to a publication of his patent?

Mr. SOUTHGATE desired to call Mr. Kay's attention to the words of Mr. Patterson—that all the suggestions in the report had been communicated to Mr. Trewby and others months ago.

Mr. KAY said every suggestion in the report might have been made, from time to time, to Mr. Trewby separately, independently, one at one time and another at another, to get separate and independent experiments made by him; but that would not be a prior publication of the patent, unless Mr. Trewby understood the whole process described in that patent, and had that process successfully in operation. It seemed to him the last effort of despair to use the letter relied upon as evidence of such a publication of the patent as would prevent it being valid. The plaintiff, in cross-examination, dealt with that letter, saying he did not communicate his process to Mr. Trewby before the date of the patent. He admitted that he communicated the causes of the failure, but the lime process had not been communicated. If the meaning of the sentence in the letter, to which he had been referred, was such as the defendants counsel chose to put upon it, the plaintiff said it must have been a slip; and, in truth, Mr. Trewby's evidence confirmed it. The result was that nothing was done at Beckton in the least like the process described in the plaintiff's patent until the 18th of February, 1872, three days after the suggestion contained in the letter of the 15th of February, and what was done on that day, and after that day, was a complete failure; it never succeeded until the report was published and the patent had been taken out, and indeed for a considerable time after that, although some little change took place in the month of March. What the defendants were doing in December, 1873, and since, they admitted to be identical with the plaintiff's process—namely, that the having two purifiers outside the houses to take out the carbonic acid, using the first and second sets of purifiers in the houses, and using the third set, charged with oxide of iron, to take out any sulphuretted hydrogen that in the process might be driven over. That was identical with the mode of working described in the patent, which was not, in fact, denied. Then, as the only thing remaining, he would deal with Mann's patent. The object Mann had in view was to take out a patent, which would provide a certain mode of doing that which had baffled all attempts up to that time. The date of the provisional specification was the 2nd of December, 1871, but the statement in that was repeated on the 1st of June, 1872. At all events, on the 2nd of December, 1871, the sulphur compounds, other than sulphuretted hydrogen, had baffled all attempts to remove them with any degree of certainty. It was a remarkable fact that, at that time, Mann was an officer of the defendant company. When asked whether the subject of his patent, in his opinion, was at the time novel, he said he thought it was. But there was no mention in it of any process for taking out carbonic acid, which was of the essence of the plaintiff's patent. Nor would the process described convert the lime in the purifier into sulphide of calcium, but partly into carbonate of lime and partly into sulphide of calcium. Again, carbonic acid was not treated as an impurity at all. It would be observed that the two defects of the patent—which were doubtless the reason for preventing its ever being used—were that it did not describe or give any process for taking out carbonic acid, and did not point to the necessity of taking out carbonic acid, first of all, by a separate operation, which never occurred to Mr. Mann's mind in any way; and the description given of the mode of producing sulphide of calcium was essentially wrong. It was proved distinctly that, in order to take out carbonic acid by the action of lime, you must regulate the speed at which the gas passed through the lime. The matter of Mann's patent was put to Dr. Odling in cross-examination, and he said there was no process described for taking out carbonic acid first, as described by plaintiff, although a process was described of making it useful when it was obtained. Mann seemed to think that the ordinary foul lime was sulphide of calcium. This was shown both by his specification and affidavit. But in the plaintiff's patent, on the face of it, sulphide of calcium was distinguished from foul lime or gas lime. It would be enough to say, upon the subject of Mann's patent being treated as an anticipation of the plaintiff's, that it had been allowed to drop because it was not worth while to pay the third £50 to keep it going, and had never been used anywhere. Indeed, it would be impossible to do so with advantage. *Betts v. Menzies*, *Hills v. Evans*, *Murray v. Clayton*, *Bovill v. Cowan* were next referred to, and quoted from, by the learned counsel, who then said that the plaintiff's process had been of great advantage to the defendants. Mr. Evans said that from Aug. 1, 1871, to the 1st of April, 1872, the average cost per 1000 feet was ·89 of a penny, and from that time they were in despair, as he (the learned counsel) said, as to keeping the impurities below the maximum. But although they had worked below the maximum since that date, the increase of expense had only been that instead of ·89 of a penny, it had been ·94 of a penny, from April 1, 1872, to Oct. 1, 1872. Before the patent it was not a question of money, but they could not do it at all; now they could do it, and they confessed they had no more trouble, and the only additional expense was 5-100ths of a penny per 1000 cubic feet of gas. The inaugural address of Mr. Livesey to the British Association of Gas Managers was next referred to, and the learned counsel said Dr. Odling, writing on the 28th of March, 1872, admitted that the question of the sulphur impurities in gas was a matter upon which very little trustworthily was known, although he had been in constant communication with Mr. Harris, and knew precisely what was done at Bow. On June 11, 1872, he delivered a lecture at a meeting of the British Association of Gas Managers, and he said in the witness-box that what he had there stated was a true representation of the state of knowledge at the time—that whatever was done at Beckton was not a trial, on a manufacturing scale, of a process which was identical with the plaintiff's, and that the variation in the impurities which existed before, and were uncontrollable, could not be controlled. Could the defendants, after Dr. Odling's evidence, maintain that the patent was not valid? He submitted to his lordship that the plaintiff had most distinctly proved that the patent, on the face of it, described clearly and intelligibly—first, with reference to the lime, under the first head the process, and under the second head the principle and process, which first process, and which second principle and process, were entirely new when the patent was taken out. He had gone through in detail, and at a length for which he felt bound to apologize, all the instances of anticipation which had been alleged. He trusted he had shown that the conclusion which Dr. Odling himself came to, was entirely justified by the detailed evidence—that neither the first process, nor the second principle and process (the principle being to take out first, by a separate operation, carbonic acid) was known, or had been practised in any way, save the experiments suggested by Mr. Patterson himself in his letter of the 15th of February, and tried to some extent, but imperfectly, on the 18th of February by Mr. Trewby, prior to the taking out of the patent. The patent was taken out on the 19th of March, and the investigation of the records at Beckton showed that what was done on the 18th of February was not done accurately and properly; because, between the 18th of February and the 9th of March, the purifiers were allowed to remain foul from 5 to 23 days in that interval.

Sir HENRY JAMES said that was not the average.

Mr. KAY said they had taken every purifier, and between those days they were allowed to remain foul from 5 to 23 days, which alone would account for the failure which everybody agreed did happen in trying the experiment which Mr. Patterson suggested. He submitted, upon all grounds, that the plaintiff had made out most clearly and distinctly that that which he had invented was really invented first of all by him; that it had been, in fact, a most useful invention, and one for which the gas companies ought, as Mr. Trewby said, to consider themselves under great obligations to him. Was it worthy of a great company, possessed of infinite means of defeating, or at least opposing, the rights of the patentee, to deal thus with an invention which they had practically admitted to be the best process they knew, by using it now at their principal works?

The VICE-CHANCELLOR: Let me ask you what decree you ask for.

Mr. KAY: My lord, I turn to the amended bill, and the decree which I ask your lordship for is for an injunction to restrain the defendant company from

using, exercising, or working the invention or process described in our patent, or any only colourably differing from them, and for an account of the gains made by the defendant company by using the processes, and for the costs of the suit. Your lordship knows it has been decided that a patentee cannot ask for both gains and damages, but he must elect which—one is the measure of the other—and I do not think it matters much which is asked for. It was settled in *Penn v. Bibbey*.

The VICE-CHANCELLOR: I do not know what difficulty may exist in chambers on the ground of taking an account of gains.

Mr. KAY: Then let it be an inquiry as to damages. We ask for an account as to damages.

The VICE-CHANCELLOR: I do not know, when it gets into chambers upon this record, how the chief clerk will proceed in taking the account.

Mr. KAY: The ordinary mode is, what damages have been suffered; and the patentee is at liberty to take in his inquiry what gains have been made by the use of the patent, or what damages he has suffered by their using it without paying him royalties.

The VICE-CHANCELLOR: It was for that reason I desired to hear from you how you shaped your case.

Mr. KAY: Perhaps, my lord, it is better to ask for an inquiry as to damages. Therefore, I will put my pleading to your lordship in that form. Practically, I believe, the same result will be arrived at, because the gain will be the measure of the damages.

The VICE-CHANCELLOR: Just so. Will you be so good as to give me your copy of the Act of 1868, for it is not printed in the Statutes, and Mr. Aston will lend me the report from which he read *Bovill v. Cowan*, which Mr. Southgate not only does not object to, but made some comments on. It is not a report of the case.

Mr. SOUTHGATE: I have not seen it, but I understand it is an authorized report.

The VICE-CHANCELLOR: It is not a reported case.

Mr. ASTON: Except to this extent, that it refers to exactly the facts which are referred to in the reported cases, but it gives them in a condensed form. Mr. Davey commented upon it.

The VICE-CHANCELLOR: If Mr. Southgate has any objection to it, I will not look at it.

Mr. SOUTHGATE: I have not seen it; how did it come to be printed?

Mr. ASTON: Because all the judgments in Bovill's cases were collected together in one volume, in order that Lord Cairns, for his convenience in giving the ultimate decision, might see all the previous decisions.

The VICE-CHANCELLOR: The only part you made use of was the judgment of Lord Cairns. Mr. Southgate, I thought you had seen it. Mr. Davey had seen it, and considered it.

Mr. SOUTHGATE: I believe so. I have not. I understand it is in.

The VICE-CHANCELLOR: Look at it, and see if you have any objection to my looking at it; if you have, I will not see it. It is only for the purpose of Lord Cairns's judgment that I ask for it.

Mr. SOUTHGATE (after looking at the document): It is taken from the short-hand writer's notes. I have not the slightest objection to it, my lord.

The VICE-CHANCELLOR: I cannot dispose of this now, but I will do so as soon as I can.

TUESDAY, FEB. 1.

The VICE-CHANCELLOR delivered judgment in this case as follows:—He said: The plaintiff in the suit was the grantee of letters patent dated the 9th of March, 1872, for improvements in the manufacture of coal gas. The defendants were an incorporated company, called The Gaslight and Coke Company, possessing several gas-works in and near the Metropolis, in which they carried on the manufacture of gas, and from which they supplied the City of London and other places. The plaintiff alleged that the defendants had infringed the rights granted to him by his patent, by using, at their works, especially at Beckton, a process for the purification of gas identical with, or only colourably differing from, his invention; and he prayed that they might be restrained from continuing such infringement, and that they might account for all the gains they had made by the use of his invention, and pay to him the amount of loss and damage sustained by him in consequence. The defendants disputed the validity of the patent on various grounds, which had been the subject of much argument, and which required to be carefully considered. But at the outset it was sufficient to say that they disputed the novelty of the plaintiff's invention, as to the method of purification described in the specification; they denied that the alleged invention was the proper subject of a patent, they suggested the publication by him of what he called his invention before the date of the letters patent, and they submitted that he was personally disqualified from suing for or obtaining a patent. The main question in the cause was the validity of the patent; but in order to determine the question, it was necessary, as well from the nature of the subject, as from the facts given in evidence, to consider the several grounds on which the plaintiff's claims and defendants objections were rested. A useful and valuable invention of obtaining artificial light from gas produced from the distillation of coal had been in common practice for more than half a century, and had undergone various improvements, which had engaged the attention of the Legislature, and had sometimes been the subject of litigation. But inasmuch as its great usefulness was not unaccompanied by danger and difficulty, and public and private inconvenience, it had been found necessary, at various times, to lay down rules for its manufacture and supply. It was not necessary to go very minutely into this part of the subject, beyond referring to the Metropolis Gas Act of 1860, by which an inspector was appointed for the purpose of ensuring a supply, by the companies, of gas of a proper quantity and quality, and the companies were required to obey the order of the Secretary of State on the inspector's reports under the penalties thereby imposed. Various other restrictions were imposed on the companies, with a view of compelling them to provide a proper supply of gas within their respective districts. By a more recent statute, the City of London Gas Act of 1868, into which the former Act was, for the greater part, incorporated, the authority of the Board of Trade was substituted for that of the Secretary of State, and the Board were authorized to appoint three referees, whose duty it was to prescribe the mode of testing the illuminating power of the gas supplied by the companies, with power to inspect the works of the companies, and investigate the processes of manufacture carried on therein, with a view of ascertaining the means adopted for purifying the gas and preventing nuisance, and to apply such test as they might think expedient for ascertaining the amount of sulphur and ammonia, and the compounds thereof, or other impurities with which the gas supplied by the companies might be charged; and to prescribe and certify the maximum amount of impurity with which the gas, when it was issued for public consumption, should be allowed to be charged. It was enacted that the gas should be wholly free from sulphuretted hydrogen, and the referees were forbidden to allow any gas to be charged with any amount of impurity in that form. Several other provisions were made, with a view of enforcing a supply by the companies of gas as efficient and as pure as might be. Under that statute the Board of Trade appointed three referees, of whom the plaintiff was one. They proceeded to discharge the prescribed duties, and became necessarily acquainted with the means, apparatus, and processes employed by the defendants in their manufacture. It was notorious, and it was admitted on both sides, that the effect of distillation from coal was to produce a vapour, which in its first state was charged with various impurities, besides those mentioned in the statute, all of which had to be removed or neutralized before gas could be brought into that condition which rendered it safe and useful for the purposes of public and private illumination. By processes of condensation, washing, and scrubbing, the crude vapour issuing from the retorts was so dealt with, that the then remaining impurities consisted of carbonic acid, sulphuretted hydrogen, and various sulphur compounds other than sulphuretted hydrogen. It was to the removal of these elements, especially the latter, that the invention of the plaintiff related. The specification, which was of considerable length, described the invention as consisting, first, of the purification of coal gas from sulphur in other forms than that of sulphuretted hydrogen, by means of sulphide of calcium, employed in separate purifiers. Secondly, it was said to relate to the principle and process of working lime purifiers, whereby the carbonic acid in the gas was eliminated by the action of the first purifier in such a manner that the lime in the subsequent purifiers was converted, either wholly or to any extent that might be desired, into sulphide of calcium. It was said further to relate to the use of washers or scrubbers, containing a solution of caustic soda, or of potash, or of ammonia, by the employment of which the carbonic acid was eliminated from the gas in such manner that, when the washers or scrubbers were placed before ordinary lime purifiers, the contents of those purifiers would be converted into sulphide of calcium, and thereafter employed in that form. When the washers or scrubbers were placed before purifying vessels containing sulphides of calcium, or sulphides of sodium, the contents of those vessels could be maintained in the form of sulphides. There were other matters mentioned in the specification, to which, for the present purpose, it was not necessary to advert more particularly. It was not disputed that, before the date of the letters patent, it was well known, to all persons acquainted with the manufacture of gas, that the vapour after quitting the washers or scrubbers contained carbonic acid, sulphuretted hydrogen, and other and different sulphur compounds, the nature and quality of which were not then, and perhaps were not now, so well known as to apply to them any specific names or characteristics. They had been called on various occasions by the witnesses, and in the course of the discussion, sulphides or bisulphides of carbon, or, generally, sulphur compounds without discrimination. Their existence or presence was, nevertheless, universally admitted. The sulphuretted hydrogen, that element in crude gas which was so peremptorily forbidden by the statute of 1868, it was known could be removed and neutralized by means of oxide of iron, and that process had been successfully adopted by the defendants. But oxide of iron had no effect upon the other sulphur compounds. Their existence and their injurious effects were well known, and it was further known that lime, in the form of sulphide of calcium—in other words, lime—was a valuable agent for purifying gas from sulphur in other forms than sulphuretted hydrogen. It was known, both chemically and practically, that carbonic acid expelled sulphuretted hydrogen, and this knowledge the defendants said they possessed before the date of the plaintiff's patent. Great care, and skill, and cost had been employed in the construction and completion of the defendants works; frequent experiments had been made, and vigilant attention had been exercised by the defendants and their officers, who appeared to be well versed in the practical appliances of the manufacture, and not to be deficient in mechanical and scientific knowledge, in endeavouring to purify the gas from the noxious presence of the sulphur compounds, but without any sufficiently successful results. The defendants had, in their answer, stated, with great distinctness and particularity, the modes in which they carried on the manufacture at Bow from the year 1867, and at Beckton from October, 1870; the various alterations from time to time introduced, especially in the last-mentioned works; the results of the experiments they made, continuing the narrative up to May, 1872, and they stated the manner in which their works were at present conducted. From October, 1871, to May, 1872, the gas manufactured by the defendants had been tested and recorded, and returns made, and it appeared that during that period the amount of sulphur, other than sulphuretted hydrogen, varied from 45·2 to 27·70 grains, all exceeding the maximum, which had been fixed by the referees at 20 in 100 cubic feet. It was not upon their own scientific knowledge, and their abundant means of experiment, and their practical skill, that the defendants only relied in endeavouring to accomplish the great desideratum of furnishing gas of such purity as the law required. They called in the assistance of chemists of well-known ability, being urged, as it would seem, to take this step in consequence of the repeated remonstrances from the secretary to the referees, founded on the returns, by which an excessive amount of impurity had been shown. In February, 1872, the defendants wrote to Dr. Odling and Dr. Letheby, informing them that the official returns had caused them much uneasiness, which was increased by the fact that all their efforts to make an alteration had so far been baffled, and requiring them to visit the works at Beckton to advise the defendants, should any means present itself to their minds by which they might secure a greater degree of purity than at that time appeared obtainable. Dr. Odling, in his reply, after expressing his readiness to help the company in the difficulty in which they were placed, observed to the secretary that he knew that the control of the amount of sulphur in gas was a matter upon which certain trustworthy knowledge was but very small. Both Dr. Odling and Dr. Letheby visited the defendants works, and each made suggestions to the defendants with a view of remedying the evil then acknowledged and found to be existing, which up to that time the defendants had expressed their inability to remove. The recommendations made by those gentlemen were in evidence. Dr. Letheby's examination of the process of manufacture and purification of gas was made, as he had recorded in his report to the secretary of the defendants, dated March 18, 1872, for the purpose of ascertaining the cause of the large excess of sulphur in the gas, and with the object of suggesting means by which the same might be obviated. He proceeded to recommend a better system of condensation, and prolonged contact of the gas with the products of combustion, the use of lime in the purifiers for a much longer time, whereby the sulphide of calcium or foul lime would act as an absorbent upon bisulphide of carbon, and would not afterwards be displaced by carbonic acid. He added that the aim and object of his suggestions were to effect the absorption of bisulphide of carbon by the alkalies of the sulphides of calcium and carbon, and also to permit the reaction of ammonia and bisulphide of carbon in the lime purifiers, so as to form sulphocyanide of calcium. He was apparently acquainted with the actual condition of the works, and the machinery there in use. He did not, however, suggest any process by which his recommendations might be applied; but, in conclusion, he appealed to the large practical knowledge of Mr. Evans, the defendants engineer, for bringing them to bear upon the question, so as to put them in the best available form. Dr. Odling, in his report of the 28th of March, expressed the difficulty he felt on account of the very small amount of positive knowledge as to the condition under which crude gas became charged with sulphur; as to the form, or forms, of combination in which sulphur occurred in the gas; and as to the means by which it was capable of removal therefrom. He then laid down certain postulates, which merely expressed facts perfectly well known to all chemists, respecting the purification of gas from sulphur by means of sulphide of calcium, and recommended, first, the decarbonization of the gas by means of lime frequently renewed; and then transmitting the completely decarbonated gas through other lime but very seldom renewed; and, finally, passing it through oxide of iron. He proceeded to recommend a process by which the decarbonization, which he considered so essential, should be effected, and pointed out that the lime in the purifiers, by its union with the remaining sulphuretted hydrogen and decarbonated gas, would quickly become converted into sulphide of calcium, capable of fixing bisulphide of carbon or sulphur compounds. He said, provided only the gas were constantly decarbonated before its admission, then there was no reason why the sulphide of calcium should not continue effective for months, or, at any rate, for many weeks. The

use and value of these recommendations by the two gentlemen appeared conclusive, as to the evidence they afforded as to the degree of knowledge which was possessed upon the subject then under consideration. The chemical principles were well known. It was a familiar thing to the company and its officers that lime would convert sulphuretted hydrogen into sulphide of calcium, and the sulphide of calcium being an alkali, would itself absorb, or neutralize, bisulphide of carbon which was acid in its nature. With this knowledge, and all appliances in their power and control, the defendants had toiled and tried in vain to reduce the sulphur in the gas within reasonable and lawful limits. The learned chemists who were consulted possessing all the same, and probably very much more, accurate knowledge, concluded that the decarbonization of the gas was the most important object to be effected, and recommended processes differing somewhat in mode, but aiming at the result by which the desideratum should be achieved. Those recommendations were made after the date of the plaintiff's patent. If they had been before, and if the tentative processes which the chemists recommended had been adopted, and had succeeded, the object was accomplished. The means of reducing the sulphur impurities within lawful limits was obtained. Nor could there be any doubt that such a discovery and improvement was a valuable one, which, at the same time that it dispelled and overcame the anxieties of the directors, furnished the public with a supply of reasonably pure gas, and would be a good ground for a patent, provided that the actual means of putting the principles they had recommended, into practical exercise and execution, had been described and resorted to. That, as it would seem, was the very invention which the plaintiff claimed to have made, when he said in his specification that it related to the purification of coal gas from sulphur by means of sulphide of calcium employed in separate purifiers, and to a principle and process of working lime purifiers whereby the carbonic acid was eliminated by the action of the first purifier in such manner as that the lime in the subsequent purifiers was converted either wholly, or to any extent that might be desired, into sulphide of calcium. Dr. Letheby, in his recommendation, having pointed out defects in the manner of working the apparatus employed—namely, the overworking of the lime purifiers, keeping the lime for too long a time in the purifiers, the insufficient condensation of the gas which took place between its issue from the retorts and the commencement of its purification by washers and scrubbers, and the use of water in the last of the scrubbers, by which too much ammonia was removed before it passed into the lime purifiers, did not say or suggest that the first operation was to be on the carbonic acid, and nowhere suggested any addition to, or any alteration in, the apparatus then in use. On the contrary, he appealed to the practical knowledge of Mr. Evans to put the principles suggested by him into the best available form. In Dr. Odling's suggestion, the first and most important thing that he recommended was completely decarbonating the gas by means of lime frequently renewed, and then transmitting the completely decarbonated gas through other lime but very seldom renewed. It was admitted, and clearly established by the evidence, that the principle of Dr. Odling's recommendation was identical with that of the invention claimed by the plaintiff, and expressed in his specification. The manner of applying that principle was nowhere mentioned by Dr. Odling. He had examined, and was well acquainted with, the apparatus and mode and working employed by the defendants. It did not, perhaps, fall within his province to suggest any improvements in the mechanical contrivances by which the primary and essential condition which he prescribed, namely, the decarbonating of the gas before its purification, should be fulfilled. At all events, he did not so suggest, but said, if it could be contrived in any way to make the decarbonated gas remain in contact with the sulphide of calcium for a longer period, a better result might be anticipated. That very contrivance was described in the plaintiff's specification. By that contrivance the decarbonated gas remained in contact with the sulphide of calcium for a longer period. That thereby a better result had been obtained was not a matter of dispute, for upon the pleadings it was apparent, and had been frequently admitted by the defendants counsel, in the course of the argument, that the process which was now used, employed, and practised by the defendants, in the manufacture of gas at Beckton, was identical with that which was claimed by the plaintiff as being his invention. The defendants denied, however, the novelty of the alleged invention, and disputed the validity of the patent upon several grounds, each of which, they said, was enough to establish the invalidity of the patent. Each objection had been argued at great length, and with consummate ability, and each was entitled to separate and serious consideration. Not the least important of them was the objection raised in the specification, which had been subjected, as it was right it should be, to a most minute and searching criticism. It was undoubtedly the law, and was perfectly just and reasonable, that a man who obtained a patent should be under the obligation of stating, in clear and intelligible terms, the nature of the invention he claimed, and the means by which that invention could be applied and practised. The construction of the specification, like the construction of all other written instruments, was in all cases for the court in which the question arose, and must be dealt with strictly, but also with a fair regard to the subject and the terms which were employed. The meaning of the plaintiff, whatever terms he employed, might be taken to be that he said to all the world, and addressing himself especially to persons engaged in the manufacture of gas, that he had found out a better mode of purifying gas than had been hitherto known and practised. The existence of impurities was notorious, the names by which they were called were known, the existing process of manufacture was known, and the failure to remove the impurities was known and acknowledged by all. The plaintiff said he was the first person who had found out that there was a principle by which the object which others had been striving at for years in vain, could be attained; and he said he would tell the world by what process that principle could be applied. Having regard to the subject with which the plaintiff was dealing, that meaning must, in all fairness, be ascribed to his specification. He did say, in very words, that he had been the first to see the importance of, and to practically carry into effect, the principle of excluding carbonic acid from lime purifiers, or from any required number of them, as a means of obtaining perfect results in the purification of gas from sulphur. The plaintiff said his invention related to the purification of coal gas from sulphur by means of sulphide of calcium, distinct from foul lime, employed in separate purifiers. That was the principle. He further said it related to a principle and process of working lime purifiers—things in use in all gas-works—whereby the carbonic acid in the gas was eliminated from the action of the first purifier or purifiers of the series, in such manner that the lime in the subsequent purifiers was converted either wholly or to any extent that might be desired, into sulphide of calcium. In subsequent parts of the specification, he explained the manner in which he proposed to apply the process. He showed the most economical manner of making sulphide of calcium, and described what he called a new principle and process of employing lime purifiers. He described one process by which several purifiers might be employed in succession, or rotation, or he said the first purifier might be constantly employed. The claim, which was at the end of the specification, he said he considered to be novel and original; and, therefore, claimed—first, the employment of sulphides of calcium in separate purifiers, as a means of purifying gas from sulphur in other forms than sulphuretted hydrogen; secondly, a mode of employing lime purifiers in the manner described, whereby the contents of all the purifiers would be converted into sulphides of calcium, and also, if required, be maintained in that condition. It had been argued for the defendants that, under the first head, the plaintiff claimed as a novelty the use of sulphide of calcium; whereas that substance, and its purifying effect upon gas, had been long known to chemists and gas manufacturers, and that the first process described being bad, on that ground the alternative process suggested by the plaintiff must be bad also; the law being, as it was truly said, that a patent granted for a claim which was bad in part must be held to be bad in the whole. But he did not think the plaintiff had, in any part of his specification, claimed the use of sulphide of calcium as his invention, or that the reference to the matter hereinbefore described vitiated or affected the claim in which those words were to be found. The objection of the defendants that the plaintiff's invention could not be the subject of a patent, did not appear to be well founded. The plaintiff did not claim the discovery of a principle only, which would not be sufficient, but a principle combined with a process, easily applicable by any person acquainted with the manufacture of gas, by which the principle might be exercised for the purpose of producing the result indicated. The other objections to the specification appeared to be groundless, because the construction of the instrument was reasonably clear, and there was no uncertainty or ambiguity it its expressions, nor did it contain any inconsistent claims; nor was it open to the objection that being bad in some respects, it must be held to be bad altogether. Then the defendants said there was no novelty in the invention, and to that point a very large proportion of the evidence adduced by the defendants had been directed. They had called the three principal officers employed at the defendants works at Beckton and Bow, two very eminent professors of chemistry, and five other persons acquainted with the chemical properties of gas, the manner in which it was manufactured, and the means by which impurities were removed from it. They all asserted that there was no novelty in the plaintiff's invention, for that by the use of lime in the production of sulphide of calcium, and by its effect on the sulphur impurities, they might, and had been, in fact, removed. All that might be perfectly true. If the plaintiff had denied it, and had founded his claim upon such denial, the evidence might have been conclusive against the patent. But not only did the plaintiff not deny the facts, but the invention adopted them. It was not satisfactory, although the practice was by no means new, to impute to an adversary something which he had neither said nor meant, and then proceed, by demolishing it, to obtain an easy and certain victory. The plaintiff said that, if he granted all the defendants had said, they did not say that they knew the first essential process of removing the sulphur compounds from the gas was to eliminate carbonic acid by sulphide of calcium, not by foul lime, but by means of separate purifiers. No one of the defendants witnesses had said he did; and until Dr. Odling pointed it out as a discovery of his, which probably it was, although made after the date of the patent, there was no trace in all the verbose and voluminous evidence which had been furnished by the defendants, that either the principle or the process described in the specification had been used or known in the manner, and for the purpose, described in the specification. If what the witnesses said were adopted, it was impossible to account for the excessive amount of impurity which the tables which were in evidence showed to have existed in the gas before the date of the patent, or for the frequent confessions of the defendants agents that they did not know how to reduce that impurity, although they were earnestly endeavouring by experiment and otherwise, and although they had called in the advice of Dr. Letheby and Dr. Odling to assist them in effecting that most desirable object. Dr. Letheby's suggestions were different from the plaintiff's invention. Dr. Odling's were identical with them; but, until his letter was communicated to the defendants, there was no ground upon which it could be said that the principle and process patented by the plaintiff were not novel. That they had been proved to be useful was established by the fact that they had been adopted and used, and were now employed. The plaintiff had also gone into extensive evidence. Besides his own affidavit, which entered very minutely into the state of the defendants works, and pointed out what he alleged to be their imperfections and causes which occasioned the particular failure to reduce or control the impurities, he referred to the table of returns by which those deficiencies were shown, and which was also in evidence. Upon many points his statements were corroborated by Mr. Pearce, one of his co-referees. Two professors of chemistry stated, without qualification, that the plaintiff's invention was new and useful, and they gave reasons upon which their opinion was founded. Six other witnesses, described as persons conversant with the manufacture of gas before the date of the patent, gave similar testimony, and deposed to the facts from which their knowledge was derived and their conclusions formed. If the case depended upon the allegations of the witnesses on both sides, the conflict between them was so great that it would be difficult, if not impossible, to arrive at a satisfactory determination. But, for the reasons which presented themselves to his mind, the questions in the case might be determined without resorting to the oral evidence alone, although it was by no means to be disregarded, nor had he neglected to consider it with the utmost attention. Another ground upon which the novelty of the patent was impeached was that a patent, which was taken out by William Mann, had anticipated the plaintiff's alleged invention. The provisional specification by Mann, filed on the 2nd of December, 1871, after stating the principal impurities, and the means by which several of them could be removed, said the sulphur compounds, other than sulphuretted hydrogen, had baffled all attempts to remove them completely with any degree of certainty. He then proceeded to describe a process, consisting of several purifiers charged with hydrate of lime, through one of which gas was allowed to pass, sufficient to convert its contents into sulphide of calcium. The crude gas was then shut off from the vessel before mentioned, and made to pass through another, by which it was freed from much of its sulphuretted hydrogen; it then passed up to the oxide of iron purifier, where it was purified from sulphuretted hydrogen, and fitted for entrance into the sulphide of calcium purifier. Then he said further it was presumed that the gas, having passed through hydrate of lime and oxide of iron, had been completely cleared from all impurities except bisulphide of carbon, and it was then free to be acted upon by the sulphide, or the sulphides of calcium, with which it would combine. The fuller specification, filed by Mann on the 1st of June, 1872, went into greater details as to the processes employed, and concluded by claiming as his invention the use of sulphide or sulphides of calcium, formed and used in the order and manner there described. The order and manner there described were not only not the same as those mentioned by the plaintiff, but were, in fact, the reverse. Freeing the gas from carbonic acid was mentioned, but it was said to be effected by exposure to lime or oxide of iron; and instead of being the first process, as described by the plaintiff, and proved by Dr. Odling to be a process effectual, and not before employed, it was not until after the gas had been dealt with by the other purifiers that the vessel described by Mann was to be brought into action, for the purpose of purifying the gas from sulphur compounds. Neither did Mann's specification point out the manner in which the sulphide of calcium was to be generated, or maintained as long as might be requisite. It would be enough to say that the specification of Mann, anterior to that of the plaintiff, could not invalidate the plaintiff's patent, inasmuch as it did not disclose a practicable mode of producing the effect which the plaintiff described. *Betts v. Menzies*, in the House of Lords, was a very distinct authority on that point. Besides, Mann's patent had never been brought into actual operation, but had been suffered to drop, and was no longer in existence. The defendants insisted, moreover, that the invention claimed by the plaintiff had been used by them before the date of the patent; and to this end a considerable portion of their evidence and arguments founded upon it had been addressed. They proved the manner in which the manufacture at Bow was, for several years before the patent, conducted by Mr. Harris, who employed, and still employs, two purifiers to take out the carbonic acid—a fact which, however clearly established, did not touch the plaintiff's invention; for although Mr. Harris's purifiers might have the effect of taking out the carbonic acid by means of lime, that was not the only office they performed, but were

part of a general system of purification. He did not say they were employed for the purpose of eliminating carbonic acid in the first place; and with what success they were employed before March, 1872, at Bow, was shown conclusively by the tables, from which it appeared that the average impurity at Bow, though probably below that at Beckton, in March was 22·8 grains, which was beyond the maximum; whilst, from causes which the defendants did not attempt to explain, it fell in the next month to 12·5. The defendants had endeavoured to account for the excessive impurity at Beckton by several reasons. They said the condensers were imperfect, that the temperature of the gas was too high, that the purifiers became distorted, and several other things of a similar kind. However that might have been, the excessive impurity continued, and they were unable to reduce it or to check it, in spite of all their earnest endeavours, until after the date of the letters patent, or until they had received Dr. Odling's suggestion, which, although made after, was beyond doubt identical with the plaintiff's. Mr. Trewby had stated the experiments he made at various times, which, it was insisted, were an anticipation of the plaintiff's invention. That those, whatever they were, had not been successful, was not disputed. If they had been, the cry of distress which ran through the correspondence would not have been uttered by them. He gave an account, in his letters, of numerous experiments which had been made, and their failure; and, in a letter of the 19th of February, he attributed the increase in the amount of bisulphide of carbon to the coals which had been in use, whereby, he said, the sulphide of calcium was no sooner formed, and in a state to take up bisulphide, than the carbonic acid took its place. In the same letter, after stating that within the last few days he had been working the purifiers in a somewhat different form—that he had kept certain purifiers for the purpose of taking out carbonic acid only, and the remainder for the sulphur—he said he was in hopes that would do good. If these repeated experiments had been successful, Dr. Letheby's advice might have been spared, and when Dr. Odling showed Mr. Trewby how to proceed successfully, the reply would have been that he knew it all, and had done it all. On the contrary, on the 21st of March, Mr. Trewby was acting on Dr. Letheby's suggestions, and certainly with a beneficial result, obtained, however, at a most alarming cost. And on the 22nd of March, Mr. Trewby wrote to Dr. Letheby, saying that his earlier experiments and results were not what he could have wished. He mentioned a new plan which he had adopted in February, which was in operation at the time of Dr. Letheby's visit, whereby he got down to 29 grains, since which he had reduced it to 20, and he said that at that time they had about 42 grains, which they reduced one-half in the way they were working, and he was in hopes that as they extended the system of purification, they would be able to reduce it still more. It might be that Mr. Trewby knew the presence of carbonic acid was the obstacle. Indeed, it was clear he was making experiments to overcome it, and that he had partially succeeded. But even if it were assumed, which, as a matter of fact could not be done, that he had conceived the same idea as the plaintiff, it would amount at the most to this, that two men travelling on the same road in search of the same object, the one who first obtained and described it in an intelligible and accurate expression, and who obtained a patent for the protection of what he had thus acquired, could not be deprived of it because another had tried to reach the goal before him, but did not. Then it had been said that the plaintiff's invention had been published by means of a letter which the plaintiff wrote to Mr. Trewby before the date of the patent, the purport of which was that he requested Mr. Trewby to try certain experiments respecting carbonic acid. It was written at a time when the plaintiff said he was getting materials for his specification, which he shortly afterwards filed, and because he wished to have the experiment he suggested, tried upon a large scale, which the Beckton works afforded. Without ascribing to the letter the character of a confidential communication, it was no publication. Mr. Trewby, who did not return any answer to the letter, thought so too, for he denied emphatically that he received from the plaintiff any information which guided him in the experiments which he made, or in the discoveries which were arrived at. It had been suggested, also, in the course of the argument, that the patent was invalid in respect of the 3rd, 4th, and 5th heads of the invention. Those objections could not be said to have been put fairly or sufficiently in issue by the defendants, or that any evidence had been adduced upon which they could be sustained. All the defendants said in their answer was, that they had never tried the process purporting to be described in those three heads, and had no intention of doing so, that they believed there was no novelty in any of them, and that such processes had no practical value whatever in the purification of gas from sulphur, or for any other purpose. In Mr. Evans's affidavit, he said such processes were all well-known to gas engineers, and used in the purification of gas. The statute, 15th & 16th Victoria, provided that, in actions at law, no evidence should be admitted unless the objection had been distinctly raised, and the principle of that enactment had been recognized and acted upon in Courts of Equity. The plaintiff having stated in his specification the object he proposed to attain—viz., the purification of gas from sulphur compounds by means of sulphur in a fine state of division used along with sawdust, or such like substance—said, in his 5th head, he claimed the employment of sulphur in a fine state of division, with an inert substance. Upon that it had been argued that where oxide of iron had been employed to take out sulphuretted hydrogen, some portion of the sulphur must, in that process, have been deposited on the iron, and that upon its being revivified, the sulphur so deposited would form sulphur in a fine state of division, with an inert substance. He could not, however, think that in a just mode of considering the specification, oxide of iron, which was a most active and efficient agent for taking out sulphuretted hydrogen from the whole volume of gas to which it was exposed, could be said to be one of those inert substances, like sawdust, which the plaintiff proposed to employ with sulphur in a fine state of division. The only other objection to the plaintiff's suit was directed against him personally. The answer alleged that the plaintiff, previous to his appointment as gas referee, had no acquaintance with the business processes of manufacturing and purifying gas, and the defendants believed that the plaintiff derived his knowledge of the methods which he pretended to have invented, from opportunities, afforded him in his official position, of seeing the processes employed by the company, and from information directly supplied to him by persons employed by the company. The defendants submitted to the court whether it was competent to the plaintiff to make use of the knowledge acquired by him, as a public officer in the discharge of his duties, for the purpose of taking out a patent. That objection had been earnestly enforced in the course of the argument. He could not say that he thought the plaintiff was disqualified, by reason of his employment, from availing himself of any discovery which he might have made. His duties as a public officer were very clearly prescribed by the statute under which he was appointed, and he appeared to have discharged those duties, in co-operation with the other referees, efficiently, and certainly without any censure or complaint that had been heard of. No doubt he could not have made the discovery he had, unless he had obtained extensive knowledge of the manufacture and purification of gas. How much of that knowledge was derived from information afforded to him by the company's officers, and how much of it was the result of his own inspection and observation, need not be inquired into. But whatever was the extent of the information, it did not seem to have been more than his powers under the statute would reasonably entitle him to acquire, nor to have led to the discovery in any other manner than knowledge of known laws and principles must exist before an invention can have an object to which it could be applied. He had not thought it necessary to go into the report of the referees made on the 27th of March to the Board of Trade, because he did not think it affected the real question between the parties. Many authorities had been referred to on both sides; but as the law upon the subject was perfectly familiar, and open to no doubt, it was needless to mention them. If the objections taken by the defendants were well founded, then it was clear that the patent could not be sustained. On the other hand, if those objections failed, the plaintiff's rights were established by numerous decisions. He had now gone through the principal and only important topics which had been discussed. He had attended to the discussion during many days, and had since looked through the evidence, and considered the arguments which had been addressed to him. The task had been somewhat laborious; but, having performed it as well as he was able, he came to the conclusion that the plaintiff was the inventor of the principle and process by which the purification of gas from what was called the sulphur compounds might be effected to a greater extent than had ever been practically done before the date of the letters patent; that the defendants had adopted, and were now practising, that invention; that they had been, and were able to keep down the amount of impurities in gas to an extent and degree very far superior to that which existed before the date of the plaintiff's patent rights were created. They were also able to exercise a much greater control overt hose impurities than they had been able to do previously. The defendants thus having practised the invention without the plaintiff's consent, he was entitled to the injunction prayed for by his bill, and he was also entitled to be paid by the defendants such damages as he had sustained by their unlawful use of that which was his exclusive property, and for that purpose an inquiry must be directed to ascertain the amount of such damages.

Mr. KAY: With costs, of course?

The VICE-CHANCELLOR: Yes.

Upon the application of Mr. DAVEY, for the defendants, the injunction was suspended for three months, the defendants undertaking to abide by any order the court might make as to damages in consequence of such suspension. Mr. Davey stated that the defendants might desire to take the opinion of the Court of Appeal; and if they did not do so, they would have to decide whether they should arrange with the plaintiff, or effect an alteration in their works, which could not be done under some considerable time. He undertook, in case they decided on the first-mentioned course, to present a petition of appeal forthwith.

On the application of Mr. ASTON, the VICE-CHANCELLOR said he would grant a certificate under the Act, that the validity of the patent had come in question.

Our reporter omitted to state that the solicitors for the company are Messrs. Curtis and Bedford, of Haberdashers Hall, Gresham Street, London.

QUEEN'S BENCH DIVISION.—THURSDAY, FEB. 3.

(Sittings at Nisi Prius at Guildhall, before the LORD CHIEF JUSTICE *and a Special Jury.)*

THE EUPION GAS COMPANY.

PROSECUTION OF THE PROMOTERS.

The defendants in this case are *Joseph Aspinall*, *Samuel Gurney Fry*, *George Parkyn Knocker*, *Charles Knocker*, *John Saunders Muir*, and *William Whyte*, and they are indicted for conspiracy to defraud the prosecutors, James Chapman and John Alers Hankey, by means of various false pretences and representations.

The case against the defendants first came before the Lord Mayor, at the Mansion House Police Court, on Oct. 8, 1874, and after several hearings they were committed for trial at the Central Criminal Court on the 8th of December. In February last year the defendants applied for, and obtained, a writ of *certiorari*, under which the case was removed to this court, and it now came on for trial.

The indictment contains 15 counts, varying the charge in different ways. The first count charges the defendants with having conspired to defraud the Stock Exchange Committee by falsely pretending that 34,365 shares had been taken, and £17,182 paid. Another count stated that they conspired to represent that Fry had 15,000 shares to sell, whereas he had not, and that various persons of means were prepared to be purchasers, whereas they were really agents of the defendants. Another count stated that the defendants conspired together to induce various persons to purchase shares, and to prevent them being delivered, so as to defraud out of the sums they would have to pay for the shares. Other counts stated the charge more generally as conspiring to cheat the brokers by means of false pretences.

The SOLICITOR-GENERAL, Mr. POLAND, and Mr. BESLEY appeared for the prosecution; Mr. POPE, Q.C., Mr. METCALFE, Q.C., and Mr. MOODY for Aspinall, Serjeant BALLANTINE and Mr. W. BALLANTINE for Charles Knocker; Mr. COLLINS and Mr. HODSON for Whyte; Mr. KEMP for Fry; Mr. ORMEROD for George Knocker; Mr. KEOGH for Muir.

The SOLICITOR-GENERAL, in stating the case to the jury, said the conspiracy with which the defendants were charged was for the purpose of defrauding the members of the Stock Exchange. By the 99th rule of the Stock Exchange a broker who sells is bound to deliver to the broker who buys the stock with which he proposes to deal. If he did not do so at the appointed time, apart from the question of carrying over, the buying broker might purchase, for any price he could get, the shares originally bargained for, and any difference in price must be paid by the original selling broker. The principal defendant, Aspinall, who concocted the fraud, was a sharebroker at Liverpool, and the originator of the Open Stock Exchange. He was perfectly acquainted with the mode in which business was carried on on the Stock Exchange, and it occurred to him that, if he could get a sufficient number of confederates to carry out the scheme, it would be an exceedingly advantageous and profitable thing to the broker of the new company, by keeping the shares in his own hands, and having the entire control over them, in enhancing their value according to the demand. It would appear in the course of the investigation that the defendants never had at any time the control of more than £3000, and on Sept. 29, 1874, the brokers who had fallen into the trap had made themselves liable for £100,000. One was filled with amazement, and to some extent admiration, at the extreme ingenuity with which this performance was effected, and if the bubble had not burst and the fraud been detected, a very much larger sum might have been realized by the confederates. The defendants were persons wholly without means, and, in consequence of the high price of coal, they decided upon starting this company. It appeared that Muir had registered provisional specifications of two patents, which expired during the early days of the Eupion Company. A Mr. Kromschröeder had a patent of a similar character, which expired in October of the same year. A Mr. Voight had a patent, which he sold to Muir, on behalf of the company, for £100, and upon that the Eupion Fuel and Gas Company was started, with £50,000 capital, in 50,000 shares of £1 each, with power to increase the amount at any moment. Aspinall was a stockbroker who had failed in Liverpool. He came to London and was engaged in the Open Stock Exchange, and more or less in getting up and being connected with companies. Fry was the person represented as entitled to the valuable patent rights to which allusion was made in the prospectus of this company, for which £40,000 was said to have been paid, £25,000 in cash, and £15,000 in fully paid-up shares in the company. In order to show the Committee of the Stock Exchange that this was a going concern, and that the company were entitled to have a quotation and a settling-day named, the course pursued was this: George Knocker was related to the manager of the Midland Bank, where Muir had an overdrawn account at the Leeds branch to the extent of £12,000, and he was indebted to the bank in a much larger amount in connexion with another person. That was the only capital apparently with which the company started. Aspinall and Muir drew bills from time to time, and paid them into the bank, and Charles Knocker, the secretary, drew on them, on the Midland Bank, and by that means they obtained £3000. The defendants then induced their friends to apply for shares, and the

mode of procedure was to pay a certain sum into the London and Provincial Bank, purporting to be 10s. each, on application for shares. The money so deposited was again drawn out and again paid in, until there appeared to have been a sum of £35,000 subscribed for shares, and which entitled them to apply to the Stock Exchange for a quotation and a settling-day. Having obtained this, the confederates were enabled to take the next step in the fraud, which was to induce brokers to contract for the sale and delivery of shares in the company, and this was done by Muir and Aspinall, acting in collusion. One of them got buyers and the other sellers of shares, and the result was sales of 14,500 shares and purchases of 12,970. Thus the brokers would be bound to deliver nearly £15,000 of the shares, all of which were in the hands of Aspinall, so that he would have been enabled to command his own price for them, and, perhaps, to defraud the brokers out of £200,000, or more. All the defendants took different steps conducing to this end, and but for an accident would have succeeded. Parratt, the chairman of the company, who was not implicated in the fraud, but was made use of as a cat's-paw, alarmed at something he heard, made a communication to one of the brokers, who thus obtained a clue, and made discoveries which resulted in a disclosure of the fraud. It was found that the pretended allotments and the pretended payments for shares were collusive. It was found that the pretended sales and purchases were also collusive, and instigated by Muir and Aspinall; and that they, while inducting brokers to enter into these contracts, retained the control over all the shares.

Some formal evidence was then given, after which Mr. *F. A. Voight* was called. He said: I am an engineer, residing at 36, Grafton Road, Kentish Town. I am patentee of Patent 3185, dated Oct. 1, 1873, for "Improvements in the apparatus used in the production of gas from hydrocarbon liquids." On Jan. 12, 1874, I signed an agreement for the sale of the patent to Dr. Muir, for £416 13s. 4d., in three monthly instalments by promissory note. They were never paid. I received only £100 13s. 4d. by several instalments. On the 8th of June I cancelled the agreement. Muir had the offices, 165, Cannon Street, before the company was formed. I do not know what he was or what business he carried on there. I saw Aspinall several times at the offices in Cannon Street, and also several of the other defendants. I saw the prospectus of the company after its formation, and the patents were stated in that document to be purchased for £25,000 cash and £15,000 in paid-up shares. I called on Mr. Aspinall at his offices in Gresham Street. Mr. Whyte was there also. I had received no payment of the promissory notes, and I asked Mr. Aspinall how he intended to settle the matter. He said he had nothing to do with Dr. Muir's promissory notes or with his agreement. He said I could have the amount in shares of the company, but I preferred to have money, according to the arrangement. Aspinall said he would consider about it, and let me know. He did not give me any explanation of the statement in the prospectus. About the middle of May, I saw George Knocker at the company's works at King's Cross. I worked there for the company in making the apparatus for the manufacture of gas, according to my patent. Knocker said if I would sign the paper he produced everything would be right. By it I was to be paid a larger amount in shares, and stand in Dr. Muir's place. I suppose he meant Dr. Muir's interest in the company. I declined to accept the terms offered. I applied for 1000 shares in the company on March 20, 1874. I paid no money on application, or on allotment. I received no allotment, letters, or notice. At the time of the application, I signed a transfer of the 1000 shares in blank. That name has since been filled in. I gave both to Mr. Hastings, and left them with him at the offices. The transferred shares are in Joseph Aspinall's name.

Cross-examined by Mr. POPE: This was done at the instance of Mr. Hastings, who was interested with me in my patent. I supposed that all the documents were cancelled on the 8th of June. The patent was an invention of mine to produce a cheap illuminating gas. I assisted Mr. Kromschröeder in a similar patent. His was then expiring. They were two different processes, producing the same results. The works were commenced at King's Cross after the experiment at Great Marlow. The company submitted Kromschröeder's process to several well-known gas engineers, who approved of it, and experiments were tried at Great Marlow. It was perfectly successful for lighting the town. It was after that that the works were commenced at King's Cross. The town of Great Marlow was lighted several nights under the process. It is not intended for large towns, but for small ones, and factories, and private houses. I saw Lord Morley at the works on one occasion. The company seemed to him to have a fair prospect of success.

In re-examination, the witness stated that he was not aware that any of the processes were in use now. He believed, however, that the company's processes might have got into use, and machinery to the value of several hundred pounds had been ordered, but these proceedings had put a stop to the company.

Evidence was given that two other of the patents expired in 1874, but it appeared that Voight's was still in existence. It also appeared that in April, 1874, Muir obtained certificates of "provisional protection" for two processes, which, however, did not result in patents.

Witnesses were then called to prove that they had been induced to apply at various times for shares in the company, that they paid no money, got no letters of allotment, but executed transfers in blank.

FRIDAY, FEB. 4.

A number of witnesses were again examined to prove that, at the request of one or other of the defendants, they had applied for shares, varying in number from 200 to several thousand shares, executing, at the same time, blank transfers. Some of the applicants were mere boys, and occupying no higher position than that of lawyers clerks.

Mr. *John William Perkins:* I am an analytical chemist, living at Brixton. I applied for 1400 shares in the company, and executed a blank transfer at the same time. I posted the documents to Mr. Aspinall. I did it at Dr. Muir's request. I got no allotment. I procured the last witness to sign an application for shares. Dr. Muir said the directors wished to obtain as many shares as they could, but they did not wish them to appear in their own names. He asked me to get as many friends as I could to apply for shares, so as to divide them as much as possible. Dr. Muir gave me a number of forms of application, and as many blank transfers.

Cross-examined by Mr. METCALFE: I investigated scientifically the merits of the invention, at the request of Dr. Muir. I went to Great Marlow, and my opinion was that if it could be carried out on a large scale, with sufficient capital, it was an important and valuable discovery. There was considerable agitation going on at the time about the gas supply. I was perfectly satisfied with it when I saw the apparatus tried at Great Marlow.

Cross-examined by Mr. KEOGH: Dr. Muir paid my expenses. I advised Dr. Muir to take out two patents, and he did so. I was told that when he transferred the patents he ceased to have any connexion with the company. Dr. Muir must have spent a large sum in endeavouring to perfect the invention.

Mr. *John Annan*, gas engineer, Wolverhampton: At Mr. Whyte's request I applied for 150 shares, and at the same time executed a blank transfer.

Cross-examined by Mr. POPE: I am the engineer to the Wolverhampton Gas Company. I gave a certificate of my opinion of the Eupion process after inspection at Great Marlow. I also made private experiments to satisfy myself. I believed it to be admirable for villages, private mansions, and churches, but not for large towns, and I believe so still. I was prepared to receive my remuneration in paid-up shares. I considered it a *bonâ fide* and good undertaking. The gas could be produced at 4s. 6d. per 1000 feet. Gas is now 2s. 9d. in Wolverhampton. In some provincial towns it is 8s. and 10s. per 1000 feet. The illuminating power of the Eupion gas was 18 candles. With one burner it was 22 candles. At Wolverhampton we supply 14-candle gas.

By Mr. COLLINS: I made the experiments at Mr. Whyte's request.

Re-examined: I believe it was Kromschröeder's patent I tested.

A short discussion ensued on the pronunciation of the word "Eupion," upon which the LORD CHIEF JUSTICE said no doubt the "i" and "o" were long. It occurred in the "Odyssey" and "Iliad," and meant "rich, abundant in fat," but he did not know how that was applied to gas.

Mr. *W. R. Cooper*, gas engineer, of Banbury, deposed that he also applied for shares, and at Whyte's request investigated the gas at Great Marlow, and gave a favourable certificate of its illuminating power. He put the cost of production at about 3s. 3d. per 1000 feet, and expressed his opinion of its value for small villages and isolated mansions, and as a valuable adjunct to coal-gas works. He recommended the use of Eupion gas to the Duke of Marlborough for lighting Blenheim House. He was content to take his remuneration in paid-up shares. He did not expect to get the allotments, because Whyte was to sell them for him, and give him the proceeds.

By the LORD CHIEF JUSTICE: The gas is made from a light spirit obtained from petroleum.

Mr. *E. Baker*, gas engineer, of Reading, said he was offered 750 shares for making experiments. He was afterwards told that number had been reduced to 335, and he signed the transfer to Whyte. He never made any further application for shares. The cheque produced, dated April 9, 1874, for £140, was not paid to him. He never received any money in respect of shares.

Cross-examined by Mr. POPE: He was still of the same opinion as to the value of the invention.

After some further evidence respecting applications by request of defendants for shares, transfers for which (in blank) were signed at the same time, evidence was given by persons who had been induced by defendants to become directors.

Mr. *G. F. Parratt*, late chairman of the company, was examined. He said that through Whyte he made the acquaintance of Aspinall, and afterwards went to Cannon Street, where Muir explained to him the nature of the spirit from which the gas was to be generated. Whyte had previously told him that a person owed the Ruabon Colliery a considerable sum of money, and that the only way he saw of obtaining it was to assist his debtor in carrying out a patent for the purpose of making air gas, that a company was about to be formed for that purpose, and if he (witness) would consent to be a director, he (Whyte), having the power to appoint two directors of the company, would give him 200 shares. Witness was to be his nominee on the direction, because as Whyte was supplying a large quantity of coal to gas companies, his name on the direction would damage him in his business. He added that some rich City friends were going to take up the whole of the shares, and that he had nothing to do with the money part of the business. He spoke of the experiments about to take place at Great Marlow. At Cannon Street, Muir explained the extraction of the spirit from the petroleum, and witness frequently called there to see the experiments. Two rooms were fitted up with generators, and the tests, in his opinion, were most admirable. He saw the gas generated by the machines, and tested the difference of illuminating power with coal gas—the difference being 26 Eupion gas to 14 coal gas. He was much struck with its probable value. He afterwards attended a meeting of promoters on the 13th of February, and agreed to join as director. The whole question was then entered into and discussed. Mr. Aspinall said he had got promises for the whole amount of the capital, and he was asked at what price. He replied that if he was allowed to expend £500 for preliminary expenses, he would undertake to do everything that was agreed to. Witness afterwards signed the Memorandum and Articles of Association, and attended the subsequent meetings of the company. He called on Aspinall at his request, when he asked him to take 1000 shares to oblige him, saying that he would lend witness £500 to pay into the National Provincial Bank. Witness signed the application and blank transfer at the same time, but did not receive the money. He was to have it when necessary. He did not get the money, and he paid none on application or allotment. He retired from the directory when he saw that proceedings had been taken against Dr. Muir with reference to a colliery in the north. He knew nothing about the application and allotment of shares, or the purchase of the patents, or the financial condition of the company.

SATURDAY, FEB. 5.

The cross-examination of Mr. *Parratt* was commenced this morning. He said this was the first company he had ever been connected with. Up to the last he had no reason to doubt the *bona fides* of the undertaking. There were a number of generators being manufactured at the works at King's Cross. It was a substantial factory, at a rental of over £300 a year, and there were fair prospects of doing well.

The LORD CHIEF JUSTICE: What led you to say, as you stated yesterday, that it was a gross swindle?—In inducing me to act as trustee for shares that had been sold in the market twice over. I considered that I was to be trustee of the shares, to prevent the "bears" from operating against the company.

But for that, then, in your opinion, this would have been a sound undertaking?—Yes.

Have you any doubt now?—The only doubt was, whether air gas would be affected by cold weather, and whether the spirit could be obtained in sufficient quantity to make it. The petroleum wells had then failed to a great extent.

Are you of opinion now that, as things stood then, it was a sound undertaking, and do you think so now?—Yes.

Then the fault you find is the selling of the shares?—Yes.

Then the fraud, if any, was on you, and not on the public?—Yes, exactly The orders uncompleted, at the time of the collapse, were afterwards completed by the liquidators.

Witness was cross-examined at some length as the proceedings of the defendants in reference to the financial dealings with the banks.

The depositions of Mr. *Holmes*, barrister, one of the directors, now deceased, was then put in evidence. It stated that he applied for 1000 shares, and executed a blank transfer at the same time, and handed the documents to Mr. Aspinall. He believed the company to be a genuine concern. He never heard of the manner in which the allotment of shares had been carried out, until this prosecution was instituted. He resigned in consequence of hearing that "something was being done on the Stock Exchange." He did not know what it was.

This was followed by further evidence of persons who had been induced to make applications for shares and sign blank transfers, by defendant Aspinall. One of them, a barrister, named Beechcroft, said that Steel, a lawyer, who had acted in the matter, told him that Aspinall had got a very good thing, and that he was anxious to keep it as far as possible to himself, that he was anxious to start a company at once, and that in order to do so, it was necessary to furnish the Stock Exchange with a list of names of persons holding a certain number of shares; that it was an every-day proceeding to give the names of persons who had not really paid for shares. Witness said that was rather curious, and that he should make inquiries. He did so, and judging by the answers generally given——

The LORD CHIEF JUSTICE: Of what class of persons did you make inquiry?

Witness: Mostly friends and acquaintances; but I am not much acquainted with the Stock Exchange; and from what they said I concluded it was not such a curious transaction, or, at all events, that there were transactions equally curious.

The LORD CHIEF JUSTICE: If this be joint-stock companies morality, limited, it is to be deeply regretted. I hope this exposure may lead to better results. (To witness:) Take my advice, and do not lend your name to a similar trans-

action. Although you intend no fraud, you thereby allow other people to perpetrate a fraud.

The evidence of the manager of the Midland Banking Company, at Leeds, as to the mode in which the banking transactions with the company were carried on, occupied the court till the close of the sitting.

The case is likely to last several days.

DUBLIN CONSOLIDATED NISI PRIUS COURT.—Friday, Jan. 28.

(*Before Chief Justice* Morris.)

DISPUTED GAS ACCOUNT.

TAAFE, *Appellant*, *v.* ALLIANCE AND DUBLIN CONSUMERS GAS COMPANY, *Respondents*.

Mr. Porter, Q.C., and Mr. Monroe appeared for the appellant; and Serjeant Armstrong, Mr. J. Gibson, Q.C., and Mr. Byrne for the respondents.

This was an appeal from a decision of the chairman of the county of Dublin, in a case in which the Alliance and Dublin Consumers Gas Company were plaintiffs, and Mr. Robert Taaffe, solicitor, of Idrone Terrace, Blackrock, defendant, reported in the Journal of the 11th ult. The action was to recover a sum of £6 11s. 4d. for gas alleged to have been supplied to the defendant. The amount in dispute, however, was only 11s. 11d., being 10s. 8d. for 2000 feet of gas, alleged to have been consumed during the quarter ending September, 1874, and 1s. 3d. for meter-rent. The balance, £5 19s. 5d., had been lodged in court. The case sought to be made in the court below was that Mr. Taaffe, being apprehensive that he was being charged for more gas than was being used in his house, discontinued the use of gas for the entire September quarter, and that, notwithstanding this, the above-mentioned charge was made. The defendant had not given any notice to the company of his intention to discontinue the use of gas, but on being sworn he stated that on being furnished with the account, he wrote on March 19, 1875, stating that he had not used any gas "from towards the close of June, and had used none for the ensuing quarter." The plaintiffs proved that the meter indication showed that between the 17th of June and the 22nd of September, the 2000 feet of gas charged for had been consumed, and it was contended for the plaintiffs that the gas might have been consumed between the 17th of June and "towards the end of June," the time when the defendant stated he had ceased to use the gas. Defendant could not, in the court below, state the exact date on which he had discontinued the use of gas, but he produced a servant who swore that it had not been used during the "summer quarter;" but on cross-examination she said she did not enter the defendant's service till the 5th of July. The chairman granted a decree for the amount claimed, and from this decision the defendant now appealed.

Mr. *F. Hanvey*, the company's district inspector, was examined, and stated that his inspection occupied about six weeks, and that this accounted for the inspection of defendant's meter for the June quarter being made on the 17th of June. The meter on the latter occasion indicated 56,500 cubic feet, and on the 22nd of September following the indication was 58,500, the difference representing the quantity of gas consumed in the interval. In December following, the meter indication was 79,000.

Cross-examined by Mr. Monroe: There were not many complaints in his district; but there had been complaints of overcharges.

Mr. *W. F. Cotton*, the company's secretary; Mr. *Conolly*, the inspector of meters for Dublin; and Mr. *Sporne*, inspector of meters in the City of London, were also examined, and stated that it would be impossible that a meter such as that used by the defendant could over-indicate the quantity of gas consumed. Mr Sporne said he had subjected the meter to ten different tests, and had taken the indicator apart, and he had never met with a more perfect instrument in all his experience.

The *Appellant*, his wife, and son, were examined, and their evidence was to the effect that the gas had been turned off on the day the inspection was made by the first witness (the date of which, however, the witnesses could not fix), and that for the following quarter candles and oil had been used. Mrs. Taaffe stated that during the preceding quarter, when 2900 feet of gas were charged for, the dining-room, two lobbies, and kitchen jets were in constant use, and the drawing-room in occasional use.

In cross-examination, Mrs. Taaffe stated that about a fortnight or three weeks after the inspection in June, a man called to put water in the meter; but it was from the time of the first inspection, and not of the second, that the use of the gas was discontinued.

Eliza Grace, who had been a servant in the employment of Mr. Taaffe up to the 7th of July, deposed that the gas had been cut off two months before she left.

Mary Touhy, who succeeded the last witness in Mr. Taaffe's service, deposed that no gas was used from the time she came until the 1st of September, and on that day young Mr. Taaffe showed her how to turn on and off the gas. Mr. *Taaffe*, jun., said that this occurred on the 22nd of September.

Mr. *Hanvey*, being recalled, stated, in answer to inquiries by the court, that although it was very unusual for an indicator to show precisely evolutions to the extent of 2000 feet, it was occasionally the case. He could not explain how 2000 feet of gas could have been consumed by them in the summer months, by the occasional and surreptitious use of one burner in the kitchen, while in the more wintry months preceding, when the gas was being used throughout the house, only 2900 feet had been consumed.

The learned Judge, in giving his dicision, said the Act of Parliament had been referred to, and it contained a provision that the meter indication should be *primâ facie* evidence of the consumption of gas; but it was not contended, and be would scout the idea, that it could be held to be conclusive on that point. He was asked to hold not only that the meters were infallible, but the gas inspector and readers of indicators could not make a mistake. The defendant, it appeared, in 1874, apprehensive that he was being overcharged, took the most excellent course in the world, that of discontinuing the use of the gas altogether. There was some monstrous suggestions that by using the tongs the servant or some one else had turned on the gas for the sake of burning it, but he would not leave the atmosphere of fact for such a gassy atmosphere as that. In the face of theory there was the sworn testimony of witnesses that the gas had not been used during the quarter. To suppose that 2000 feet of gas were burned in this quarter, when it could only have been used surreptitiously while 2900 only were used in the preceding quarter was ridiculous. He believed no gas had been used by Mr. Taaffe during the quarter in dispute, and he should therefore reverse the chairman's decree with the usual costs.

Mr. Porter applied for costs of witnesses, Mr. Robert Taaffe, jun., having been brought over from Netley.

The application was granted.

Judgment for the appellant.

Tin-lined Lead Piping.—It is stated that this make of pipe has been adopted for the water supply of Dresden. It resisted eight atmospheres on official trial, but in actual use give way under a pressure of five atmospheres. The municipal authorities prescribe certain weights per current mètre for piping of all dimensions; but even heavier and stronger piping than that prescribed does not answer; and the makers of tubing, on whom the discredit of the failure has been thrown, have declared it impossible to make satisfactory goods. They have recently joined in a petition to the Town Council of Dresden, for a repeal of the regulations concerning water piping, the make of which they pray to have left a matter of arrangement between themselves and their customers.

Miscellaneous News.

THE GASLIGHT AND COKE COMPANY.

An Extraordinary General Meeting of the Shareholders of this Company was held at the Offices, Horseferry Road, Westminster, on Friday last—Simon Adams Beck, Esq., the governor, presiding—for the purpose of considering the bill to be introduced by the directors in the present session of Parliament, for granting further powers to the company.

The Secretary (Mr. J. O. Phillips) read the notice convening the meeting, and also the heads of the various clauses of the bill as deposited in the Private Bill Office.

The Governor: Gentlemen, since this bill was prepared, and the notice of this meeting was given, many important questions have arisen, and required our serious consideration. We have had a conference with the Board of Trade, the Metropolitan Board, and the Corporation of London, the result of which is that the bill will necessarily have to be materially altered; but, independently of that, we have received this morning a most important letter from the Board of Trade, suggesting a totally different mode of raising any future capital we may require, to that which we proposed by this bill. As this letter has only just come to hand, we are really not in a position to-day to recommend anything for your adoption. I will briefly state to you what has taken place. In the first place, at the meeting we had with the authorities, the Board of Trade accepted, as the initial price for gas, 3s. 9d., instead of the 4s. inserted in our bill, and after considerable discussion we thought it desirable to give way and accept that price, with a sliding scale of dividend, giving us an increase of one-quarter per cent. for every penny we reduced our gas below 3s. 9d., and a decrease of one-quarter per cent. for every penny we charge above that price. On this condition they agreed to our making a reserve-fund. All the parties present at that interview agreed to these terms generally, except the Metropolitan Board, who required time to consider them. I do not know whether, since then, they have given their decision to the Board of Trade. The only question left in doubt between us was, as to the mode of raising any new capital we may require. We agreed, after careful consideration amongst ourselves, to accept the Commercial Act of last session, thinking that, if we did so, it would settle the agitation which has been carried on against us, for years to come, if not for ever. Mr. Newton's own words were, "It will settle it for all time." We accepted, therefore, the principle of that Act, which is to raise all new capital, half in debentures at 5 per cent. interest, and half in shares, with 7 per cent. dividend. We thought it was equitable, and we have agreed to it. But, now, we have a letter from the Board of Trade to-day, suggesting that fresh capital shall be raised, partly by shares, and that those shares shall be offered by auction to the public; and that any premiums obtained by the sale of the shares shall go to the capital account of the company, and not to the benefit of particular shareholders. Well, gentlemen, this is so important a question, and has come before us so recently, that we are not, at the present moment, prepared to give you any recommendation on the subject, especially as we are now in negotiation with the Imperial and Independent Companies, and a scheme for the amalgamation of those companies with our own is actually before the Board of Trade. We have a meeting this afternoon, at half-past two, with the directors of those companies, to consider together the proposition addressed to us by the Board. Under these circumstances, therefore, what we wish to ask you is, that you will give us an open resolution in this form—"That the bill now read to this meeting be approved, subject to such alterations as the directors may deem expedient." If you have sufficient confidence in us to leave the matter in our hands, we ask you to pass that resolution. I think we have always done the best in our power for your interests, and, as the result proves, we have worked well. The proposition made to us by the Board of Trade involves most important questions; the principle has never been applied to any large company. In some provincial towns it has been done, but never in connexion with a London company; and it requires much consideration before we can decide whether it would be advantageous or not. I move the resolution I have just read.

The Deputy-Governor (the Hon. Howe Browne) seconded the motion.

Dr. Puckle: I think now is the proper time to make a few observations. I quite agree in the statements which have been made by the governor; but I came here for the purpose of moving a resolution, particularly with reference to the 13th section of the bill which has been laid before the meeting. I do not disagree with anything proposed by the directors, except as to the mode of raising new capital—viz., by debenture bonds. If we agree to such a proposition, we shall have no right hereafter to apply to Parliament for additional share capital, and if we did we should immediately be told that we had the power to raise all the money we wanted on debentures.

The Governor: Allow me just to interrupt you. That proposition will be struck out of the bill; because, under the Commercial Company's Act, the principle of which we have told the Board of Trade that we accept, we shall be entitled to raise one half of our new capital by loans at 5 per cent., and the other half by shares at 7 per cent.

Dr. Puckle: That is not the proposal that was read just now to the meeting.

The Governor: No; because the Standing Orders of Parliament require that the bill should be read to you exactly as deposited. But if we adopt the principles of the Commercial Act, that clause will be struck out. Since the bill was prepared, that principle has been accepted.

Dr. Puckle: I think, then, that in order to strengthen the hands of the directors, it would be well to add to the resolution moved by the governor, in which I agree, the following words—"That this meeting is of opinion that it is not desirable to raise the whole of any future issue of capital which may be required for the purposes of the company, by means of loans on mortgage of the company's undertaking, or debenture stock; and that such a proceeding would be injurious to the interests of all classes of shareholders in this company."

The Governor: Before any gentleman seconds this addition, I beg to say that I think it would be a little inconvenience in tying us down to any resolution by this meeting, in reference to a subject which we are going to discuss with the other companies. Give us your confidence, and rely upon it we shall do our best to serve your interests. It would be no use for us to meet the directors of the Imperial and Independent Companies to discuss this question, if we have a resolution binding us in this way.

Mr. Yool: As a point of principle, I entirely coincide with my friend behind. At the same time, I decline to second his motion, because I think it would be inexpedient that the hands of the directors should be tied. It is certainly not desirable that we should be saddled with a large amount of mortgage debt or preferential stock, especially in the case of a company with a limited dividend. The effect would be that, in the event of a fluctuation in the price of coals for example, by which the profits were much reduced, the whole of that reduction would fall upon a comparatively small share capital, instead of a large one. I say, therefore, it is undesirable, looking to the restrictions which exist in our present Acts, that we should be forced to raise new capital wholly by means of debentures, or preferential stock. If we did so, and there was a reduction of, say, £100,000 in the profit of some future year, it would seriously affect the rate of dividend upon a small proportionate share capital. I hold it so inexpedient, considering the present state of negotiations with other companies and the Board of Trade, to tie the hands of the directors, that I trust no

gentleman will second the proposed addition to the resolution proposed by the governor, and that we shall leave the matter in the hands of the court.

Mr. STOKES: Supposing the directors come to an agreement with the other companies on the point in question, it will not, I suppose, be finally adopted until confirmed by another meeting of shareholders.

The GOVERNOR: As far as the Standing Orders are concerned, you must express your assent or dissent on the particular proposals of the bill before you now.

Dr. PUCKLE: If I understand that the directors assent to the principle that it is not expedient the future capital should be raised in the manner described in section 13 of the bill, I shall willingly withdraw my proposition.

The GOVERNOR: We have agreed to withdraw that section, by agreeing to accept the principle of the Commercial Act, with reference to raising new capital. The other question is what we have to discuss with the companies.

The motion was then put, and carried unanimously.

Mr. STOKES moved, and Dr. PUCKLE seconded, a vote of thanks to the governor and directors, which was cordially adopted.

The GOVERNOR acknowledged the compliment, and the proceedings terminated.

PROPOSED ADOPTION OF THE AVERAGE METER SYSTEM IN ST. GEORGE'S, HANOVER SQUARE.

At the Meeting of the Vestry of this Parish on the 20th ult., a Report was brought up by a Sub-Committee appointed to consider the advisability of Lighting the Public Lamps of the Parish by the Average Meter System. The report recommended that in future the whole of the lamps should be lighted a uniform number of hours, and, instead of the lamps being lighted as at present (some 4380 hours, others 4500 hours), a modified system of lighting be adopted. That in consequence of the saving likely to be thus effected, a competent person be appointed to act as gas inspector, whose duty will be to constantly examine the various lamps throughout the parish, with a view of detecting any lamps either not lighted, or not consuming the stipulated quantity of gas, or that may be deficient in illuminating power, to call the attention of the gas company to such as may come under his notice, and to personally test or see tested with the officers of the company such burners and regulators, and to report generally on the state of the lamps weekly to the Committee of Works. That a uniform quality of gas be consumed throughout the parish, if possible; the committee being of opinion that it is not desirable to pay for two sorts of gas—viz., cannel and common—at two separate prices, as is now the system. That, with a view of ascertaining the actual quantity of gas consumed, a limited number of the most improved meters be fixed to certain lamps in such parts of the parish as the committee shall hereafter decide, the lighting and extinguishing of which to be entirely under the control and management of the surveyor for a given time. That, as it may hereafter become advantageous both to public and private consumers in the parish, pressure-gauges should be fixed, in the in and out wards, to test the pressure of gas supplied. And, lastly, that in the event of the gas company objecting to the adoption of these suggestions (if approved of by the Committee of Works and Vestry), the meter system be adopted.

The report of the committee was accompanied by a special report made by the surveyor (Mr. Livingston), as to the desirability of introducing the average meter system into the parish, with an estimate of the cost. It states that the total number of lamps in the parish is 2606. The lamp-posts and lanterns are the property of the vestry; the burners, taps, and governors are the property of the gas companies.

The total amount paid to the gas companies for the supply of gas under contract, estimated at this year's prices, is as follows:—

London Gas Company.	891	lamps, at	£3	15	6	each =	£3363 10 6
Gaslight and Coke Co..	942	,,	3	6	1	,,	3112 10 6
Ditto do. .	773	,,	3	19	8	,,	3079 2 4
							£9555 3 4

This includes lighting, cleansing, and repairs. The average amount, however, of the past four years, is £10,272 12s. 8d.

The total number of hours lighted is given as 4500 by the London Gas Company, and 4380 by The Gaslight and Coke Company. The quantity of gas contracted for is 2½ feet per hour for cannel, and 4 feet per hour for common.

Assuming, therefore, that each lamp burns the given number of hours, and assuming also that each consumes its proper quantity of gas—namely, 2½ feet and 4 feet per hour respectively, the total annual cost would be as follows:—

	Cubic Feet.	Cubic Feet.		
London Gas Company, 891 lamps, burning 2·5 feet per hour for 4500 hours . . . . . =	10,023,750			
Gaslight and Coke Company, 942 lamps, burning 2·5 feet per hour for 4380 hours . . . . =	10,314,900			
		20,338,650 at 5s. =	£5084	13 3
Gaslight and Coke Company, 773 lamps, burning 4 feet per hour for 4380 hours =	13,542,960	at 3s.9d. =	2539	6 1½
	33,881,610		£7623	19 4½

Leaving a balance for lighting, cleansing, and repairs, of £1931 4s., or about 14s. 9¾d. per lamp.

The surveyor gives it as his opinion that "the present system of contracting for the supply of gas at so much per lamp cannot be a satisfactory one to the ratepayers, because the quantity of gas guaranteed by the company, and paid for by the parish, may not be, perhaps is not, actually consumed; but this may arise from various causes easily explained, and certainly not, I think, from any intention on the part of the gas companies to do an injustice to the consumers."

A statement is given showing that the first cost of introducing the meter system is estimated at £2464 13s., and the annual expenditure (including cost of gas) £10,606 12s. 4d., being a total yearly loss by change of system of £1051 9s.

Upon this state of things the surveyor remarks—

"It will be seen by the annexed statement that the introduction of the meter system into this parish might not be attended with any saving. Apart, however, from any pecuniary benefit which might be derived from it, I am of opinion that it is undoubtedly the best to adopt. I do not say this from any hostile feeling towards the gas companies, but simply because I believe the principle of the system in question to be the fairest and most satisfactory for all parties concerned.

"That the introduction of this system will, to some extent, affect the gas companies, and to their disadvantage, *must be admitted*, for it is undoubtedly true that an unmetered lamp will consume more gas than one having a meter attached, the loss of pressure due to friction being about 0·15 of an inch. I should not imagine, however, that any gas company would attach such importance to this difference as to raise any objection to the adoption of the system.

"The Vestry of Paddington show a saving of 12 per cent. by the adoption of the meter system in that parish. Nearly 8 per cent. of this is due to an alteration in the hours of lighting. I do not think it fair to credit the meter system with a saving which is due to a reduction of the hours. The only saving that can be effected, if any, is in the difference between the *actual* quantity of gas consumed and the *estimated* quantity paid for. I will assume, therefore, this parish to be losing a proportionate quantity of gas to that stated to have been *saved* by the parish of Paddington since its adoption of the system.

"In the parish of Paddington, the loss upon each lamp consuming 5 feet per hour is stated to have been 0·23 feet.

"The proportionate loss, therefore, upon each lamp in this parish consuming 2·5 and 4 feet per hour at the present number of hours, is 0·12 and 0·18 respectively, and the result is as follows:—

	Cubic Feet.	Cubic Feet.		
891 lamps, burning 2·38 cubic feet per hour for 4500 hours . =	9,542,610			
942 lamps, burning 2·38 cubic feet per hour for 4380 hours . =	9,819,784			
		19,362,394 at 5s. =	£4840	12 0
773 lamps, burning 3·82 cubic feet per hour for 4380 hours. . . . . =	12,933,526	at 3s.9d. =	2425	0 8½
			£7265	12 8½

Paid to gas company . .	£7623 19	4½
	7265 12	8½
This would show a saving to the parish of . . .	£358 .6	7¼ = 4·7 per cent on gas only."

The surveyor appends a detailed statement showing that by making an alteration in the present hours of lighting and extinguishing, a saving of £1378 2s. 2½d., or about 18 per cent., might be effected, and a total saving of about 21 per cent.

In conclusion he says: "I may add that I have received information on this subject from nearly 100 towns in England and Wales; and, although not at liberty to make it public, as it was given to me in confidence, I may say this much,—that in nearly every town where the meter system is carried out, it has given satisfaction; and in others where it has not yet been adopted, it is approved of, and recommended both by the gas companies and the local authorities. One reason for this, I believe, is, that such a system prevents any unfriendly feeling existing between the two bodies. I am therefore inclined to believe that the London gas companies would fairly entertain any reasonable proposals made to them by this parish, and would, moreover, willingly assist in introducing any system likely to give mutual satisfaction."

The report of the committee was appoved and adopted by the vestry, and referred to the Committee of Works to carry out.

CAMBRIDGE UNIVERSITY AND TOWN GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held on the 27th ult.—the Rev. Dr. PHELPS in the chair—when the following report was presented:—

The directors submit to the shareholders a statement of accounts for the half year ending Christmas, 1875, which accounts have been duly audited. The directors recommend a dividend for the half year after the rate of £10 per cent. per annum on the consolidated stock, and after the rate of £7 per cent. per annum on the amount paid-up on the new shares, as well as £2 per cent. per annum on the consolidated stock and shares, on account of the deficiency in the dividend paid for the half year ending Midsummer, 1873, payable on the 1st of February next, free of income-tax. The directors, looking at the large balance against the capital account, and the expenditure in extensions and improvements of the company's plant, have made a further call on the new shares of £3 per share; this call will realize £3744. In consequence of the death of Mr. H. G. Atkins, one of the auditors of the company, it will be necessary to elect some gentleman, being a shareholder, to fill up the vacancy thus created.

The report of the manager (Mr. Weeks) was appended:—

I beg to report a steady increase of the business of the company. Additional mains for lighting the district of Sturton Town have been laid, and several new public lamps, ordered by the Improvement Commissioners, fixed. The supply to the town has been well maintained, with the slight exception of the Brookland Avenue, for which district a new main must be laid, during the ensuing summer, on the Trumpington Road. A fair amount of repairs has been made to the plant, to maintain all in thorough working order. The illuminating power and purity of the gas has been kept fully to the required standard, with, I hope, satisfaction to the public.

The CHAIRMAN moved the adoption of the report, and congratulated the company upon the prosperous state of their affairs.

Mr. S. PEED seconded the motion, and said the company had now recovered the position they had lost. Mr. Weeks might have stated in his report that the increased consumption of gas was due to the marvellous increase in the town. The town was increasing rapidly, and, of course, that meant increased comsumption of gas. There was one other point he might mention, and that was with regard to the manager's report. From what he had seen of the manager, he had been led to entertain a high opinion of him, and he would suggest that the directors formally acknowledge the manager's report by stating that it was annexed to their report.

The motion having been adopted, the dividends recommended in the report were declared, and Mr. G. W. Fitch was appointed an auditor in place of the late Mr. H. G. Atkins.

On the motion of Mr. S. PEED, a vote of thanks was given to the Rev. Dr. Phelps for his able conduct in presiding over the meeting.

The CHAIRMAN, in acknowledging the compliment, said he anticipated a prosperous future for the company. The price of coal had probably, indeed, gone to the lowest, or nearly to the lowest, point; but, if the iron trade revived, which he trusted it would, coal would probably rise again in price. The matter of gas companies had now been so fully discussed, and so many able reports had been issued upon it, as to lead them to hope that the public were really beginning to understand the various questions relating thereto. The JOURNAL OF GAS LIGHTING, which advocated and explained the interests of gas companies, was so ably, impartially, and honestly conducted, that he could not help thinking that the public would become more and more acquainted with the real matter at issue, as regards these companies. Not only gas companies, but the public at large, were infinitely indebted to that journal for the able manner in which the question was handled, both scientifically and financially, and that, too, not in the spirit of a mere partisan and defender of gas interests, but with a full and fair recognition, in every case, of the rights and interests of gas consumers. He had read most of what had been written upon the subject, and believed, in spite of difficulties that might arise, that the company might look forward to the future with confidence.

The proceedings then terminated.

CAMBRIDGE WATER-WORKS COMPANY.

The Half-Yearly Meeting of Shareholders was held on the 28th ult.—the Rev. Dr. OKE presiding.

The directors report recommended that a dividend on the consolidated stock, and on the first call upon the new £2 shares, for the half year ending Jan. 6, 1876, and on the second call upon the new £2 shares for the quarter dating Oct. 6, 1875, at the rate of £10 per cent. per annum, be paid on the 1st day of March next, free of income-tax. It stated that, in consequence of exceptionally heavy fall of rain during the last half year, the consumption of water supplied through meter had been much less than usual. The subject of the proposed extension of the company's works, mentioned in the last paragraph of the engineer and manager's report, was receiving the careful consideration of the directors. The retiring directors were Mr. Dennis Adams, Mr. Charles Balls, and Mr. Edmond Foster, who were eligible for re-election.

The engineer and manager (Mr. Henry Tomlison) in his report stated that, during the past half year, water from the company's works had been laid on to 112 premises, the increased rental derivable from which was £123 per annum. The total number now supplied was 6474. The general condition of the company's works was satisfactory. With a view to meet the increasing demand for water, it

would soon be necessary to augment the pumping power at the company's works, and to add strength to the means of distribution in some particular localities of the town.

These reports were adopted, on the motion of the CHAIRMAN, seconded by Rev. G. B. F. POTTICARY; and, on the motion of the CHAIRMAN, seconded by Mr. M. BROWNE, dividends as recommended by the directors were declared, and the retiring directors were re-elected.

The shareholders unanimously passed a resolution on the motion of Mr. FENWICK, seconded by Canon HOPKINS, to the effect that the remuneration of the directors be increased from £150 to 200 guineas.

The CHAIRMAN, on behalf of himself and the other members of the directorate, thanked the shareholders for their kindness, and took the opportunity of acknowledging the valuable services rendered to the company by their engineer and manager.

A vote of thanks to the chairman concluded the proceedings.

NORWICH WATER-WORKS COMPANY.

The Half-Yearly General Meeting of Shareholders was held on the 26th ult.—Mr. H. S. PATTESON in the chair.

The notice convening the meeting having been read, a conversation arose as to the printing and circulation of the accounts half yearly, among the shareholders, prior to their meeting, and it was ultimately referred to the directors to consider the advisability of such a course,

The SECRETARY (Mr. Cooper) read the report of the directors, which was as follows:—

The accounts of capital and revenue for the half year ending the 29th of September last now read by the secretary have been carefully investigated by the auditors, who have certified to their correctness in the usual manner.

After payment of working expenses, debenture interest, and preferential dividend, and including the balance of account carried over from the previous half year, there remains a sum sufficient to pay a dividend on the ordinary shares at the rate of £5 10s. per cent. per annum, deducting income-tax, leaving a balance of £396 12s. 1d. to the credit of the next half year's account. The directors have therefore declared a dividend at that rate, which will be paid to the shareholders on the 31st inst.

The company having raised £120,000, being the whole of its authorized share capital, and taken up £40,000 on debentures, being the whole of the money authorized to be borrowed under the existing Acts of the company, the directors have taken the necessary steps for applying to Parliament in the ensuing session to raise additional capital, and also to extend their limits of supply to the parishes lying just beyond the hamlets of the city. A special meeting is intended to be held on the 2nd of February, when the parliamentary bill will be submitted for the consideration of the proprietors in compliance with the standing orders of Parliament.

The directors have to express their regret at the loss they have sustained by the death of Mr. Frederick Brown, one of their colleagues, which they feel sure will be shared by every proprietor who had the pleasure of knowing him. The deceased had taken a deep interest in this company from its formation, and had the esteem and regard of his brother directors and of every person connected with the company.

The directors who retire by rotation are Messrs. R. A. Bacon, Henry Back, and E. C. Bailey, who being eligible offer themselves for re-election.

The directors are happy to state that the works and machinery are in complete order and efficiency.

The CHAIRMAN, in moving the adoption of the report, said he could not refrain from congratulating the shareholders on the present state of the company, which was progressing very favourably. The statement of account showed that the amount of their business was increasing. All the works were in an efficient state. All must regret the death of Mr. F. Brown, who was one of the origiual directors, and in conjunction with the late Mr. Sultzer, carried on the new mills when they were in their hands. The death of Mr. Brown was a great loss to the directorate. His place had been filled by Mr. Bailey, in whom he was sure the shareholders would have confidence, as he would give additional strength to the board.

Mr. FITCH seconded the motion, which was put and carried.

Mr. Wade, Mr. R. A. Bacon, Mr. H. Back, and Mr. E. C. Bailey were re-elected on the board of directors. Mr. R. J. Wright was re-elected auditor; and the remuneration paid to the auditors was increased from £20 to £30 per annum.

A vote of thanks to the chairman, the directors, and Mr. Ayris, was agreed to, and the proceedings terminated.

PROPOSED TRANSFER OF THE BURSLEM GAS-WORKS TO THE LOCAL BOARD.

On Tuesday, Jan. 25, Major Tulloch, R.E., one of the Inspectors of the Local Government Board, held an inquiry at the town-hall, Burslem, in reference to an application by the Local Board of that town for sanction to borrow (amongst other sums) the sum of £80,000 for the purchase of that portion of the undertaking of the Burslem and Tunstall Gas Company which supplies their district.

After the usual formalities had been gone through,

The INSPECTOR said: I will take an opportunity of examining the works before I leave the town. The main point is whether it is a good undertaking, and I have no doubt that my examination will confirm what I have already heard about it. There can be no doubt about the general question, that all gas, sewerage, and water-supply works should be in the hands of the local authority. The inspector went on to explain that the object of private companies was to provide good dividends, whereas local authorities were actuated by the double desire to provide a good article and to keep down the rates.

Mr. HULME proceeded to give a history of the movement. After explaining how the bad quality and insufficiency of the gas supplied had led him to bring the purchase of the gas-works before the board, he went on to show how the board had first offered £60,000, but had subsequently, on a closer examination of the company's books, accepted the present offer of £80,000. Going into the question of figures, he said that the balance-sheet for the year ending March, 1875, showed a balance of £3591. The company had been in the habit of laying out a very large sum in repairs, and in that year they laid out £2736, which was £1000 more than necessary. In a neighbouring town during the same year £778 only had been laid out in repairs. That town had just purchased its gas-works for £64,000, but their income was only £2788, and capitalizing the difference between their income and the income of the Burslem Company at 5 per cent., they got £16,000, which added to £64,000, made exactly the sum they were about to give for the Burslem Gas-Works. Adding together the £3591 balance in hand, £200 fees for directors, £100 to be saved in salaries, £1000 excessive repairs, and £111 interest on reserve-fund, they would get a sum of £5002, which he calculated would be about the net income the board would derive from the gas-works. From this must be deducted the interest on the purchase money at 4¼ per cent.—say £3400, and they would have £1602, available for the reduction of the rates of the town, or for the reduction of the price of gas.

In answer to the INSPECTOR, Mr. HULME said he put down 4¼ per cent., because he believed they would be able to borrow money at that rate.

The INSPECTOR: Do you propose to borrow the money from the Public Works Loan Commissioners?

The CLERK: They have written to us to say they won't lend money for any of these purposes under 5 per cent.

The INSPECTOR: I should like to see the letter. [The letter was here handed to the inspector.]

Mr. HULME said that since 1870 the income of the company had increased £900, and probably would increase in the future. He added that an agreement had already been made for the purchase of the gas-works.

In answer to a question, Mr. HULME said that the present price for gas was 4s. per 1000, with a discount of 12 per cent., supposing the quarter's account were paid within two months.

Mr. OAKDEN: I should like the board to have the reserve-fund.

In reply to a question, Mr. OAKDEN said he thought the consumers had a right to prevent the shareholders from dividing the reserve-fund, because they had already received their full dividends.

The INSPECTOR said that was a matter which lay outside the present inquiry.

Mr. HULME said that matter would be best left alone now. Action in it ought to have been taken before. He believed that in consequence of their excessive expenditure, the works were in capital order, and were fitted up with every appointment necessary to carry on a larger production of gas.

The INSPECTOR said it seemed to him to be a very reasonable arrangement. They were going to give £80,000 for what no doubt was a very good undertaking. Of course, in parting with a profitable concern, the shareholders wanted an equivalent to what they would receive in the shape of dividends. Supposing they invested £80,000 in the funds at 3½ per cent., that would bring in £2800, and if they calculated £8000 original shares at 10 per cent., £15,000 second shares at 7½ per cent., and £13,000 at 7 per cent., they would get £2835.

Mr. HULME said in all probability the shareholders would invest their money at a higher rate of interest than 3½ per cent.

The INSPECTOR: Of course they would.

Mr. WATKIN said he thought the inspector ought to know that for a great many years the gas-works only paid 5 per cent., and in one year they paid nothing.

Mr. TENNANT thought the inspector should know that the directors presented each holder of two shares with a bonus share a few years ago, and he believed they were in a similar position now.

In answer to questions by the INSPECTOR, the CLERK said the company actually did supply Wolstanton, Sneyd Green, and North Rode. The two latter were in the parish of Burslem, but outside the board's district. The mains were laid, and these places were now being supplied. He was of opinion that the board would be able to continue this supply, as it was one of the liabilities of the company which they took by the purchase. He believe that Lieut.-Colonel Cox, who held the inquiry at Longton, decided that they could supply a district which was ten times the area of Longton.

The INSPECTOR said it was a question for a legal gentleman to decide. It would be very unfortunate for them if they found that they really did not possess the power to supply those districts, and that another company were started.

In reply to the INSPECTOR, Mr. A. SHAW said the outlying parts of the district could not be benefited by another company.

The INSPECTOR said he would take care they were put in a right position, so that there should be no mistake in the future as to whether they were really about to buy the power to supply the outlying districts prescribed in the Act.

METROPOLIS WATER SUPPLY.

ROAD WATERING ON THE THAMES EMBANKMENT.—At the usual weekly meeting of the Metropolitan Board of Works on Friday last, the Works and General Purposes Committee submitted a report in reference to the supply of water by the New River Company for the purpose of watering the Victoria Embankment, which stated that they had considered a report by the engineer on the memorandum of agreement for the supply of water to the Embankment during the season of 1876, and having had before them the Water Companies Act of 1852, it appeared to them that the provisions of section 41, relative to supplying water by meter in certain cases, were applicable to the supply required for the Victoria Embankment, and under that section the charges were, when the quarterly consumption of water shall not exceed 50,000 gallons, 7½d.; when exceeding 50,000 gallons and not exceeding 100,000 gallons, 7d.; when exceeding 100,000 gallons and not exceeding 200,000 gallons, 6½d.; when exceeding 200,000 gallons, 6d.; and a further rate, not exceeding £25 per cent., in respect of water so supplied at an elevation of more than 60 feet above Trinity high-water mark. The Committee entertaining these views were not prepared to advise the Board to enter into an agreement with the New River Company as proposed, but were of opinion that they should be requested to supply the water by meter under the provisions of the section referred to. Mr. Richardson moved the adoption of the report. Mr. Dresser Rogers thought the Board might employ a fire-engine, and pump the water from the Thames for the purpose of watering the roads. Mr. Legg was of opinion that the cost of obtaining water from the river would be more than the amount demanded for the supply by the New River Company. Mr. Richardson also thought they might raise sufficient water for their purposes from the Thames, more economically than a supply from the New River Company; but having referred that matter to the engineer, he had reported to them that it would be more costly than obtaining their supply from the company. The report was then received and adopted.

MANCHESTER WATER SUPPLY.

At the Meeting of the Manchester City Council, on Wednesday last, a report was presented by the Water-Works Committee for the past year, which showed that the receipts to Dec. 31, 1875, amounted to £199,350, the principal items composing that sum being—Rentals of 1874, £12,914; public water-rate, 1875, £23,100; domestic rate, 1875, £24,368; water sold for trading purposes, including rentals for domestic supply beyond the limits of the city, £96,259; annual payment from Salford, £6500; chief and other rents, £2783; bankers and other interest, £5142. The balance owing bankers at Dec. 31, included in the total already given, amounted to £27,901. The payments made during the year were—Balance owing bankers at Dec. 31, 1874, £18,870; interest upon loans and annuities, £82,726; chief and other rents, £4462; rates, taxes, and tithes, £6548; sinking-fund account, £22,345; and under the head of expenses of working and management, for materials, contracts, wages, and expenses of maintenance, £15,690; works at Woodhead reservoir, £19,505; cleaning and pitching Gorton reservoir, £11,683; wages in connexion with general business of the department, £4965; salaries, £3347; collection of rates and rentals, £3725.

The committee estimate the income for the present year at £213,298, including an estimated deficiency of £36,184. The report states: "In explanation of the increase in the estimated deficiency for 1875 from £3084 12s. 7d. to £24,240 18s. 6d., it will be seen from the accounts that £7015 0s. 5d. in excess of the estimate was paid as interest as the consequence of the large purchases of land; also that a sum of £5851 12s. 11d. beyond the estimate was expended at Gorton Lower reservoir, and further, that the amount expended at Woodhead exceeded the estimate by the sum of £9442 3s. 3d., which amounts will, when added to the estimated deficiency of £3084 12s. 7d., account for the sum of £24,240 18s. 6d. In the estimate for 1876, it will be observed that there is an estimated deficiency of £36,184 9s. 11d., which is caused by the sinking-fund charged by the Water-Works Act being increased from 1 to 1½ per cent. during the present year, and amounting to the sum of £11,878; the estimated expenditure on the Upper Gorton reservoir also amounting to £14,000, which works are charged to revenue, and including, of course, the before-mentioned sum of £24,240 18s. 6d.

The committee recommend to the council to make a public water-rate of 3d. in the pound, and a domestic water-rate of 9d. in the pound, to be levied upon all property assessed thereto, for the purpose of raising the amount required for payment of the expenses connected with the supply of water within the city during the year commencing on Jan. 1, 1876. The amount of estimated available rates outstanding on the 31st of December last, out of a gross sum of £46,793 5s. 2d., was £127 14s.; and of rentals £74 13s. 9d., out of a gross sum of £105,325 7s. 11d.; no arrears on account of rates or rentals for any previous year are outstanding.

The committee state that they continue to extend the supply of water by meter for trading purposes, being the mode of supply most equitable for all parties, and by which also great waste is prevented. The testing and stamping of water fittings continue to progress satisfactorily. During the year 46,313 water fittings have been examined and tested, of which 44,306 have been passed and stamped, and on inspection, after connexion, the whole of such fittings have been proved to have successfully stood the pressure of water. During the year the internal water fittings in 48,211 houses, warehouses, and other premises have been inspected, and waste therein prevented by putting the fittings into proper repair, in accordance with the regulations of the Corporation. 6802 cases of inspection of rates and 6421 cases of rentals have been examined by the inspector and his assistants during the year, and have subsequently been disposed of by the Sale and Supply Sub-committee.

During the year upwards of 5½ miles of new iron piping have been laid in place of old piping, on renewals account. Upwards of 9½ miles of iron piping have been laid in extensions in various townships, and during the year connections have been made to 5845 additional houses and other premises, at an expense of £1227 2s. 6d.

During the year the full quantity required by the Act of Parliament has been delivered to the millowners on the river Etherow, and a continuous and unlimited supply has been provided for all purposes within the district of the Corporation. All the completed reservoirs and works connected with them, and the whole of the piping, have been maintained in a satisfactory condition. The committee have during the year paid out of revenue an additional amount of interest accruing upon the further cost incurred for the works being executed in the Valley of Longdendale, and also the expenditure which has been incurred in the works at Woodhead reservoir, and they have again set apart a sum in the revenue account for the renewal of old mains and service mains for the present year.

The works at the Woodhead Embankment have proceeded more rapidly than was originally contemplated, so that water is now held to within 8 feet of top level, and in the course of this spring the reservoir may be filled. The average level of the puddle is now 3½ feet below the waste weir. The height from the foundation to the present level of the puddle is 150 feet. The works at the Bottoms reservoir are nearly completed. The reservoir has been gradually filled with water to its full height, the level of the overflow being reached for the first time on the 26th of January. So far everything appears to be quite satisfactory. When fully tested, all flood waters may be sent through this reservoir, so as to allow of the timber trough (temporarily placed in the line of the flood watercourse) being removed, and the completion of the masonry at these points. The lining of the length of tunnel between Bottoms reservoir and Arnfield Brook has been completed, and only 150 yards remain to be driven between Arnfield Brook and Hollingworth Brook. The lining in this portion of the work is also in progress. The drawings for the road diversions, and for the sewer for the diversion of the foul water from the Gorton reservoirs, are nearly ready, so that the work may very shortly be let. The cleansing of Upper Gorton reservoir is now being commenced. This, together with the stone beaching and pitching, will occupy about 18 months. The cleaning out of the deposit in Lower Gorton reservoir has been finished, and the stone beaching and pitching will be completed in about two months—but little remains to be done; this work has also been proceeded with more rapidly than was originally contemplated.

AMERICAN GASLIGHT ASSOCIATION.

[Condensed from the Report in the *American Gaslight Journal.*]

WEDNESDAY, OCT. 20, 1875.

(*Continued from page* 164.)

Dr. CHANDLER continued his address as follows:—

Petroleum and Naphtha Gas.

Had I not already consumed much more of your evening than I intended, I should discuss somewhat in detail the many processes which have been suggested for making gas wholly or in part from petroleum, naphtha, or residuum. At this late hour of the evening I can only make a few general remarks on this topic.

For a long time many doubted the possibility of making a permanent, uncondensable gas from these materials. There is no difficulty, however, in doing this. Petroleum is a mixture of hydrocarbons of the marsh gas or paraffin series, the members of which constitute an homologous series—that is, differ from each other by a common difference of CH_2. The first member of the series is the marsh gas, or methane, CH_4, which is one of the chief constituents of coal gas; the second is ethane, C_2H_6; the third propane, C_3H_8, and so on.

As these paraffins become more complex they become less and less volatile, their boiling points become higher and higher, and as soon as the boiling point is higher than the temperature of the air, the paraffin appears as a liquid. Finally the melting point, becoming lower and lower, falls below the temperature of the air, and we have solids. If you glance at the diagram, you will see the entire series of hydrocarbons of which petroleum consists.

The Paraffins, or Marsh Gas Series of Hydrocarbons.

Names.	Formulæ. C_nH_{2n+2}.	Carbon.	Hydrogen.	Boiling Points. Degrees, Fahr.	Specific Gravity.	Density. Beaume.
Methane, marsh gas.	CH_4	75·00	25·00	A gas.	..	..
Ethane	C_2H_6	80·00	20·10	A gas.	..	..
Propane	C_3H_8	81·81	18·19	A gas.	..	..
Butane, Quartane .	C_4H_{10}	82·80	17·20	34	0·600	106
Quintane	C_5H_{12}	83·33	16·67	86	0·628	98
Sexane	C_6H_{14}	83·72	16·28	154	0·669	86·5
Septane	C_7H_{16}	84·00	16·00	200	0·699	72
Octane	C_8H_{18}	84·21	15·79	242	0·726	64·5
Nonane	C_9H_{20}	84·38	15·62	278	0·741	60·5
Decane	$C_{10}H_{22}$	84·51	15·49	321	0·757	56·5
Endecane. . . .	$C_{11}H_{24}$	84·61	15·39	360	0·765	54·5
Dodecane. . . .	$C_{12}H_{26}$	84·70	15·30	388	0·776	52
Tridecane . . .	$C_{13}H_{28}$	84·78	15·22	422	0·792	48
Tetradecane . . .	$C_{14}H_{30}$	84·85	15·15	460	..	..
Pentadecane . . .	$C_{15}H_{32}$	84·90	15·10	496	..	..
	$C_{16}H_{34}$	85·04	14·96	..	..	..
	$C_{20}H_{42}$	85·11	14·89	..	..	..
	$C_{23}H_{48}$	85·18	14·82	..	..	..
	$C_{25}H_{52}$	85·23	14·77	..	..	..
Paraffin	$C_{27}H_{56}$	85·26	14·74	Solid.	..	31·5
Paraffin	$C_{36}H_{62}$	85·31	14·69	698	..	..

You see that the first three are gases, while the last members of the series are solids—the substance known in commerce as paraffin. In the refining of petroleum this series is separated by fractional distillation into several portions; the first, or most volatile, consists chiefly of the third, fourth, and fifth members of the series, the gases escaping condensation. The burning oil, or kerosene, includes the 12 or 15 members next following. The residuum includes the last members, and yields the solid paraffin and the lubricating oil. This diagram shows the various commercial products, as obtained by fractional distillation.

PRODUCTS OF THE DISTILLATION OF CRUDE PETROLEUM.

Price in Bulk, 14 *Cents. per Gallon.*

Gravity. Beaume.	Name.	Per Centage Yielded.	Gravity. Beaume.	Uncondensed, Loss.	Price per Gallon. In Bulk.	Price per Gallon. Retail.
Degrees.	Gases.		Degrees.		Dols.	Cents.
115 to 105	Cymogem	..	110	Condensed by pump; made by one firm only for an ice machine; boils at 32° Fahr. .	1·50	..
105 ,, 95	Rhigolene	..	100	Condensed by ice and salt; used as an anæsthetic; boils at 65° Fahr.	1·00	..
95 ,, 80	Gasolene	1½	85 to 90	Condensed in worm by cold water; used in "air-gas machines," and gas "carbonizers"	Cents. 35to18	..
80 ,, 65	Naphtha	10	71 ,, 76	For *oil cloths*, cleaning, &c.; so-called "safety oil," "Danforth's oil," American safety gas," &c.; for adulterating kerosene; cleaning oil wells	7 ,, 5	12to20
65 ,, 60	Benzine	4	62 ,, 65	For paints and varnishes	16 ,, 12	20 ,, 16
60 ,, 38	Kerozene or refined petroleum . . .	55	46	Ordinary oil for lamps.	20 ,, 25	30 ,, 40
38 ,, 25	Paraffin oil . . .	19½	30	Semi-solid when cold. Chilled and pressed to separate paraffin; oil used for lubricating	18 ,, 14	..
	Coke, gas, and loss .	10	..			
	Total	100				

The refiner is not obliged to produce any lubricating oil, unless he chooses to do so; as by the process of cracking, distilling very slowly in high stills, he can split up the heavy hydrocarbons into lighter or less complex oils. Thus $C_{20}H_{42}$ may "crack" into $C_{10}H_{22}$ decane, and $C_{10}H_{20}$ decene, or into decane, nonane C_9H_{20}, and fire carbon. When petroleum, or any portion of it, either the light naphtha or the heavy residuum, is exposed to a red heat, by running it into red-hot retorts, in a liquid stream or in vapour, it is cracked in the same manner, but into simpler products, producing a rich permanent incondensable gas, consisting of marsh gas CH_4, ethane C_2H_6, propane C_3H_8, &c. There is no reason, therefore, why petroleum and its products may not yield permanent gas of high illuminating power.

Much fear was expressed lest the gas should "stratify" in the holders. Stratification can only result in two ways, either by the heavier (richer) gases settling from the lighter ones, and forming a separate layer, or from an irregular production, due to variations of the heats, by which rich heavy gas is produced at one time and light poor gas at another. The first way is impossible, gases never separate after they have been once mixed. I know this is contrary to the popular opinion, which believes carbonic acid settles because it is 50 per cent. heavier than the air, but it never does, and the theories of ventilation, which are based on the supposition that the carbonic acid preponderates near the floor, are all false. The most impure air in a room is always near the ceiling, because it is the warmest. Gas will not stratify after it has been once mixed. The other cause, irregularity in the production, may cause a temporary stratification; I say temporary, because gases will mix, no matter how much they differ in specific gravity, but a certain amount of time is necessary to make the mixture uniform.

The real question at issue is, whether it will pay to make gas from petroleum, naphtha, or residuum. The ways of making it are numerous. Some propose to use no other material, and to convert the petroleum or naphtha into a permanent gas and burn this alone. Others propose to dilute the naphtha gas with air, others with coal gas, others with water gas. Others again load coal gas or water gas with naphtha vapour and pass the mixture through a red-hot retort to crack the naphtha vapours into permanent gases, or to mix the naphtha vapour or gas with steam, and to pass the mixture through red-hot retorts.

All of these processes may be made to yield rich gas. Some can be carried out with much more regularity and certainty than others. Some result in the rapid destruction of the retorts, &c., others do not. Never having had an opportunity to personally test these various processes, I can only speak generally of them. I do not belive that gas can be made wholly or chiefly from petroleum, or any of its products, at the present time. A few small companies may use considerable quantities of naphtha, but if the New York city companies should all adopt it the price would be doubled at once—perhaps trebled. Naphtha weighs 7 lbs. to the gallon; a ton is consequently 320 gallons, and a ton of petroleum under the most favourable circumstances can only produce a ton of gas One thousand feet of rich gas, with a specific gravity of 0·700, such as might be made from naphtha, would weigh 53·69 lbs. Supposing the ton of naphtha to be converted into this gas with no loss whatever, no carbon, no tar, &c., we could get from a ton, or 320 gallons, 41,721 cubic feet, and should have no coke, tar, or ammonia water to help pay for the coal. From these data alone it can be shown that there is no profit in naphtha gas, except when naphtha is permanently less than five or six cents per gallon, which, with the present production, it can never be if the larger companies use it. When used as an enricher the conditions are quite different, and I have no doubt that in many localities it may be, and is, used with profit in place of other enrichers. As it is now in use in several different ways in this city and its neighbourhood, you will have an opportunity while here to see it in practical operation. It is a mistake to suppose that naphtha gas is a better gas for consumers than good coal gas. Seventeen-candle gas, such as is furnished by our city companies, is as rich as is desirable. Gas much richer than this is sure to smoke, at least at times, and the products from partially burned gas are very objectionable; they discolour the pictures and walls, and are very oppressive to the lungs.

Water Gas.

By passing steam over red-hot carbon, charcoal, coke, or anthracite, it is decomposed into hydrogen and carbonic acid, and if the carbonic acid remains long enough in contact with the red-hot carbon, it is converted into carbonic oxide.

$$2H_2O + C = 4H + CO_2$$
$$CO_2 + C = 2CO.$$

When the decomposition is complete, the resulting gas is one half hydrogen and one-half carbonic oxide. Neither of these possesses any illuminating power, but by using the mixture to dilute rich naphtha gas, a mixed gas of any desired illuminating power can be produced. I doubt very much, however, whether the cost of water gas is any less, considering the fuel used and the wear of apparatus, than coal gas, and it is certainly no better as a diluent; in fact it is inferior, as the flame of gas, rich in carbonic oxide, is very easily extinguished by draughts of air, to which street-lamps are always exposed.

Oxygen Gas.

A few years ago considerable excitement was created in gas circles by the new "oxygen light." It was proposed to extract oxygen from the atmosphere by a new and cheap process, and obtain light by using a compound jet supplying oxygen gas and coal gas, and directing the flame upon cylinders of lime or zirconia. Experimentally the new light was a great success, and works were erected in Paris, New York, and Buffalo. Notwithstanding the fact that the idea was condemned as impracticable by all intelligent gas engineers, the stock found ready takers. The complete failure of the project followed in due time. The oxygen cost many times as much per 1000 feet as coal gas, on account of the small yield from each retort, and the rapid wear of the retorts, &c. Two sets of mains, meters, house-pipes, and new fixtures were too serious an investment to be possible. The coal gas required carburetting to be used in burners not provided with lime or zirconia. For some time the affair was kept before the public, but it finally died out. In New York it was always "*a success in Paris and Buffalo*," and in Paris it was "*a great success in New York.*"

Before closing I will say a few words with regard to some of the advantages of gas.

I am well aware that the public generally do not look upon gas companies as public benefactors, but they may be certainly regarded as such. The great safety, comfort, convenience and cleanliness of gas, added to its great illuminating power, place it far beyond any other kind of light. One of the objections to it is on account of its smell, but in that lies its safety, as we are thus enabled to know when it escapes. It is cheaper than candles or any animal or vegetable oil. Its only rival is petroleum. That is cheaper, though in point of comfort, convenience, cleanliness, and safety, of course there is no comparison.

The lecture was illustrated by many beautiful and interesting experiments.

A vote of thanks was tendered to Professor Chandler for his lecture.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The disputes which, at the time of my last report, appeared to be on the point of verging upon serious complications at the principal Sheffield iron-works, have been adjusted for the time being by the abandoning of their proposals by the employers. The ironworkers of the whole of Lancashire South and West Yorkshire assembled in conference, by the representation of 40 delegates at Sheffield, on Saturday week, and, after having discussed the matter just mentioned, passed a resolution in favour of the men who are out on strike at Parkgate. They also determined to make a small general levy on the whole of the members of the association for the support of the Parkgate workmen, until the dispute there can be satisfactorily arranged.

Pig iron has been selling pretty well in small lots, of both forge and foundry qualities. Prices are a trifle weaker. The agents here of North country firms now quote as follows for G. M. B.:—No. 1 foundry, 56s.; No. 2 foundry, 54s.; No. 3 foundry, 52s.; No. 4 foundry, 51s.; No. 4 forge, grey, 51s. to 51s. 6d.; No. 5 forge, mottled, 50s. 6d.; No. 6 forge, white, 49s. to 49s. 6d.; refined metal, 72s.; Kentledge, 61s.; and cinder pig, 40s. per ton, net.

The brassfounders are again a little busier, and several good inquiries are abroad in the district as to forthcoming orders for gas and water pipes of large diameter, besides other castings, &c., for controlling purposes.

There has been a drop of from 1s. to 1s. 6d. per ton in household coals during the week; but no quotable change in steam coal. Blasting is now practically abolished in South Yorkshire, wedging being substituted, with slightly higher pay.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The iron trade of this district still rules dull in all the leading branches, and makers of special qualities of finished iron, who until recently have been able to report a moderately steady demand, are now beginning to experience a falling off. In the specifications actually placed, inquiries are tolerably numerous, but buyers appear to be again operating with great caution. Sheets are still in leading request, but orders are now eagerly sought for, and could easily be placed, at somewhat lower rates than the prices which have been ruling for some months past. The demand for galvanized roofing sheets is not quite so steady as was the case a little time ago, but, on the whole, a fair business is doing. The wrought tube and fitting trades of Wednesbury continue to show a steady improvement, and, as a rule, the ironfoundries are in well-sustained operation.

In pig iron there is very little business doing, the market being just now adversely affected by the prospect of easier rates for fuel; nevertheless, prices for the best qualities of South Staffordshire all-mine pigs are not weaker than last reported.

Coal is in growing abundance, the supply is now considerably in excess of the demand, and there is a belief current that a reduction in prices will be declared shortly. All classes of fuel are now pressed for sale, but buyers are holding back, in prospect of being able soon to place their orders on more advantageous terms. In the Cannock Chase district, where household qualities of fuel are chiefly raised, there is a decided falling off in the demand, owing chiefly to the mildness of the weather; and firms who, in December, were unable to satisfy the requirements of their customers, are now rapidly accumulating stocks.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is a growing depression throughout the coal trade of this district, with a decidedly easier tendency in prices, and where good orders are offered, considerable concessions are obtainable upon the list rates, which are really only nominal, except so far as retail trade is concerned. All classes of house coal are exceedingly dull, and the commoner sorts, which are very difficult to move, are offering at such various prices, that it is almost impossible to say what the real market value of this class of coal is. In the Wigan district, although some of the colliery proprietors are still quoting as high as 12s. and 13s. per ton, good Pemberton four-feet coal can be obtained at 11s. to 11s. 6d. per ton at the pit, and good Arley at about 13s. 6d. per ton; furnace and common house coal, however, vary from 8s. to 9s. 6d. per ton in the quotations which are made. The better classes of engine fuel are generally rather firmer, as there is now less production, and prices have a tendency to stiffen; but common sorts are still offering at very low rates, and in some cases small reductions have been made in slack, but this is not general.

Gas-making coal is in much the same position as last reported, and there is no material alteration to report in the coke trade.

Very few shipping orders are in the market, and for these there is a keen competition on the part of the Welsh colliery proprietors, who are underselling the Liverpool market.

Some of the principal colliery proprietors in the Wigan districts have been pressed by the smaller firms to make a reduction in colliers wages; but they decline, at present, to make any movement.

The iron trade shows no improvement, but rather the reverse. There are very few orders given out for any class of iron, and the inquiries which are in the market are simply sent out as feelers. Prices both of local and other brands of pig iron are weaker, and Middlesbrough delivered here is now offering at 58s. 9d. for No. 3 foundry, and 58s. 3d. for forge qualities; but even these low prices do not tempt buyers, as they seem to think that the market has not yet reached its lowest point. In manufactured iron, quotations are much about the same as those last given, but they are less firm, Lancashire bars delivered in the Manchester district being freely offered at £7 15s. to £7 17s. 6d. per ton.

All the finished-iron works are very poorly supplied with orders, and at one of the large steel works, the rolling mills have been stopped. General founders also complain that they are working off their old contracts, and new ones are not coming in to take their place.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of the North of England continues in a quiet state. Business last week showed no improvement upon January. The only coals for which there was a good steady demand were the best qualities of gas, which fully maintained the quotation of 10s. per ton. They are likely to remain so for some time. Second and third sorts of gas are unaltered in value—the quotations are from 7s. 6d. to 8s. 6d. per ton. They have less command of the market than better sorts. Under the present conditions of the trade, a large amount of the shipments done in gas coals are by steamers belonging to the collieries. Amazing activity is shown in getting cargoes away from the Tyne dock. The shipments of coal from that dock average fully 30,000 chaldrons a week, two-thirds of which are gas coals. The quantity of coals shipped from the Tyne dock last year exceeded 3¾ million tons, and nearly reached four millions.

The award in the steam coal trade was given last week. Mr. Herschel, Q.C., the umpire, ordered a reduction of 8 per cent. on wages. The award in the Durham coal-field will probably be published by the end of this week.

There was a general impression on the Tyne that steam coals would have been reduced 1s. 6d. per ton on the 1st of February; but the Association of Coalowners met, and determined to maintain the quoted rate of 14s. per ton. The result of this policy is that North of England coals are higher in the market than the same classes in Wales and Scotland. A good deal of trade that should have come to the Tyne is, therefore, diverted to those places.

The rate of freights from the Northern coal ports is excessively low. When merchants found there was no reduction in the price of coals, they gave ship captains the alternative of taking lower freights, or of allowing their vessels to lie unemployed in the harbours.

There has been a considerable reduction of freights for sailing ships. Rates to France are down fully £1 per keel, and other ports have had to submit to a similar reduction. Steamers are carrying coals to London at from 4s. 3d. to 4s. 4½d.; Rochester, 4s. 10½d.; Havre, 6s.; Ostend, 5s. 9d.; Dunkirk, 5s. 6d. per ton, and a tolerably fair amount of business has been done at these rates.

There was no improvement last week in the position of the iron trade in the Cleveland district. The market was flatter; indeed, shipments have fallen off. There is an absence of activity in the finished iron trade. A large number of men are out of employment at Middlesbrough and other ports. The chemical trade is quiet, the masters in this trade have given notice of a reduction of wages, which reduction the men are likely to resist. There is no buoyancy in the general manufacturing trade in the North, and business, as a rule, does not open out well. There is an absence of foreign orders, which generally come to hand at this time of the year.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

There seems to be a prospect of the gas question in Edinburgh leading to some unpleasantness through the differences in the results of the analyses made on the part of the Town Council and the gas companies. The analysis for the 26th ult., as made by the city analyst, showed an illuminating power of 26·3 candles for the Edinburgh Company's gas, with no hydrosulphuric acid, but a small amount of ammonia; and for the Leith Gas Company an illuminating power of 26·4 candles, with neither hydrosulphuric acid nor ammonia present. At the Town Council meeting where the report was read, Councillor Mossman submitted a table, showing the illuminating power of the gas supplied by both companies over a series of weeks. It ranged between 31·5 and 26·3 for the Edinburgh Company, and between 28·66 and 26 candles for the Leith Company. Mr. Mossman said that the council had no power to check the companies, while the latter had it in their power to reduce the quality of the gas as they liked. He, therefore, urged that a clause should be put in the forthcoming Act, to fix the standard illuminating power of the gas supplied by the companies under penalties. The consideration of the matter was remitted to the Lord Provost's committee. On Thursday last, a statement from the Edinburgh Gas Company's manager was published, showing from Dr. Stevenson Macadam's analyses the illuminating power of the company's gas. The average of 24 examinations in 1871 gave 31·69 candles; in 1872, 31·59 candles; in 1873, 30·79 candles, in 1874, 29·56 candles; and in 1875 (25 examinations), 30·69 candles. Three examinations during January gave 31·27, 30·27, and 30·62 candles. The results of Dr. Macadam's testings are appended.

At the meeting of the Town Council of Glasgow last Thursday, a number of minutes of the Corporation Gas Committee were submitted. One had reference to the purchase of the minerals under the ground occupied by the gas-works at Dawsholm, and it was stated that they had been purchased at a cost of £6250. Notice was also taken of the proposed sale of the ground formerly occupied by the Townhead Gas-Works to the Corporation Improvement Trustees. It was reported that Sir Windham Anstruther, M.P., had sent to the town-clerk a copy of his gas bill, as he intends to introduce it into the House of Commons during the ensuing session of Parliament, with the amendments suggested by the town-clerk, on certain of the new clauses, added. It was further reported that the town-clerk had had an interview with Sir Windham Anstruther on the subject of the bill, and he was instructed to take such steps as may be necessary to get clauses inserted in the bill sufficient to protect the interests of the Corporation Gas Commissioners, and the Parliamentary Bills Committee were requested to watch the progress of the bill, and take such steps as may be necessary to prevent the insertion into it, at any stage of its progress through Parliament, of clauses adverse to the commissioners interests.

It is worthy of mention, that the gentleman who presided the other night at the annual festival of the *employés* of the Partick, Hillhead, and Maryhill Gas Company, is at the head of a large foundry for gas and water pipes. Naturally enough, Mr. Shaw referred to the enormous extent of the pipe-founding trade in and around Glasgow. He said that there were twelve or thirteen foundries that devoted their attention, almost exclusively, to the production of iron pipes for the conveyance of gas and water into large towns and cities; and he informed the audience that there were at least half a dozen, any one of which could produce as many pipes as the whole of those in existence thirty-six years ago put together.

The question of the illuminating power of gas, and the desirability of reducing its richness, has been up before the Dundee Gas Commissioners; and it is not unlikely that, before long, a reform in that direction may be carried out. Thus,

while many consumers, and even Gas Commissioners, are asking for richer gas, it may be found more profitable to consume gas of a poorer quality.

The Larga Parochial Board, as the local authority, are now evidently making some progress in the direction of securing a suitable water-supply scheme. They have lately had under consideration a valuable report from Mr. Gale, C.E., Glasgow. However, at the last meeting of the local authority, another scheme was suggested, which seemed to meet with a considerable amount of favour.

There is nothing of any special importance to announce in the coal and iron trades. The price of iron has been very low during the week, the market being almost lifeless, and the coal trade is about as dull as it can be.

EDINBURGH GAS SUPPLY.—With reference to the analyst's report, submitted at Tuesday's meeting of the Town Council, as to the illuminating power of the gas supplied by the two gas companies, the manager of the Edinburgh Gas Company has published the following abstract of reports made by Dr. Stevenson Macadam on the quality of the gas of the Edinburgh Gaslight Company, in terms of instructions from the directors:—

		Candle Power of Gas.		
Year.	No. of Reports.	Maximum.	Minimum.	Average.
1871	24	33·83	29·56	31·69
1872	24	32·56	28·33	31·59
1873	24	32·43	28·96	30·79
1874	24	31·86	28·46	29·56
1875	25	31·43	29·68	30·69

Jan. 12, 1876. . . . . 31·27 candles.
„ 19, „ . . . . . 30·27 „
„ 29, „ . . . . . 30·62 „

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

360.—LANYON, J., Belfast, "Improvements in water-closets, and in valves used therewith, and for other purposes." Jan. 29, 1876.

373.—TONGUE, J. G., Chancery Lane, London, "Improvements in lamps." A communication. Jan. 29, 1876.

387.—CLARK, A. M., Chancery Lane, London, "An improved method of and means for producing heat and light, and the various applications thereof." A communication. Jan. 31, 1876.

392.—WEYHE, W., Bremen, Germany, "Improvements in apparatus for raising or forcing fluids." Feb. 1, 1876.

397.—BARRETT, J. H., and HARGREAVES, L., Halifax, York, "Improvements in apparatus for regulating, controlling, and directing the flow of liquids." Feb. 1, 1876.

401.—DUBOIS, J. L., Clapham, London, "Improvements in cocks or taps." Feb. 1, 1876.

414.—ADAIR, W., Liverpool, "Improvements in and connected with pumps." Feb. 2, 1876.

419.—LAKE, W. R, Southampton Buildings, London, "Improvements in lamps." A communication. Feb. 2, 1876.

426.—LAIDLAW, D., Glasgow, "Improvements in lighting railway carriages, and in the mechanism or apparatus employed therefor, the same being applicable for lighting tramway cars, ships, factories, and other buildings." Feb. 2, 1876.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

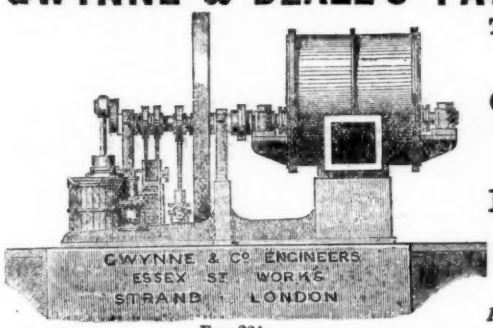


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.
HAVE MADE THE
LARGEST AND MOST PERFECT
EXHAUSTING MACHINERY
Ever produced, and the most economical in working.

Prices and every information on application.

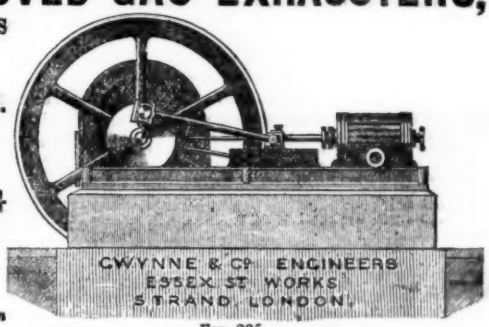
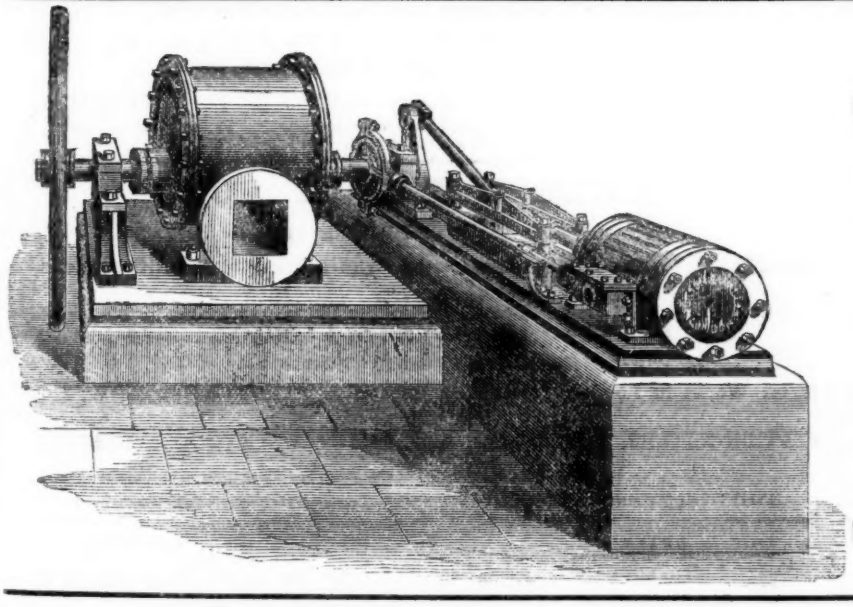


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the most perfect system of action yet discovered. Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the excellence of the article produced, and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
CAN BE HAD ON APPLICATION TO
GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.

G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.



BEALE'S
Improved Patent
GAS-EXHAUSTERS
WITH
ENGINES COMBINED.
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GEORGE WALLER & CO.

Makers of
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INDEX and DISC GAS-VALVES,
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TAR, LIQUOR, and other PUMPS,
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AND
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MANUFACTURERS OF WET AND DRY GAS-METERS;
Patentees and Sole Manufacturers of PEEBLES' LAMP-GOVERNORS,
ABOVE 30,000 OF WHICH ARE NOW IN USE.
"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*
D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

WANTED, a re-engagement as Manager of Gas-Works, where the make is from 15 to 30 millions. Thoroughly efficient. Highest testimonials and references from present and previous employers.

Address, in first instance, to No. 247, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Working Manager of a Gas-Work, a SITUATION. Can do main and service laying, meter fixing, gas-fitting, setting of retorts, clay or iron. Twelve years testimonials. Abroad preferred.

Address No. 244, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Working Manager, to take charge of a small Gas-Work in North Wales. One capable of laying mains, gas-fitting, &c. House, coal, and gas.

Address, stating wages required, and all particulars, to No. 1, care of Mr. G. W. Hughes, 4, Cable Street, LIVERPOOL.

WANTED, by the Advertiser, a situation as MANAGER of a medium-sized Gas-Works, or Outdoor Superintendent, Inspector, &c. Thoroughly conversant with the manufacture of gas and the general duties of a Manager, and can be well recommended by several Engineers.

Address No. 248, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SHEFFIELD UNITED GASLIGHT COMPANY.

WANTED, by the above Company, an experienced resident SUPERINTENDENT, to take charge of a Gas Station capable of producing 3 million cubic feet per day. He must thoroughly understand the manufacture and distribution of gas.

Applications to be addressed to the CHAIRMAN not later than Saturday next, the 12th inst., giving references, and stating age and salary required.

WANTED, a re-engagement as Working MANAGER, where the make is not less than 5 millions. The Advertiser has had 20 years practical experience (nine years in a previous situation) in the erection and management of works, and the distribution of gas. Can do his own extensions and repairs. Good references and testimonials.

Address No. 246, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS MANAGER.

WANTED, a thoroughly competent PERSON, to undertake the management of the Ashton Gas-Works.

Applications, in own handwriting, accompanied by testimonials, and stating age, experience, and salary required, to be sent in not later than the 19th of February, 1876, addressed to the CHAIRMAN of the Gas Company, ASHTON-UNDER-LYNE.

N.B.—Any candidate canvassing a Director or Directors of the Company will be ineligible.

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

HINTS ON GAS BURNERS, &c.

By MAGNUS OHREN, A.I.C.E., F.C.S.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

ON SALE, cheap, Four second-hand PURIFIERS, 10 ft. square, with dry centre-valve and lifting gear. Thorncliffe make.

Apply to Mr. LONGWORTH, Dukinfield, MANCHESTER.

FOR SALE—A 6-in. Governor, in good condition. Now replaced with a larger one.

Apply to Mr. W. DUFF, Manager, Gas-Works, MORECAMBE.

FOR SALE, in consequence of enlargements, Two PURIFIERS, 6 ft. square, with valves grids, covers, and lifting crane complete. Also Vertical Condenser, 8-in. pipes and chest, in good order.

Apply to W. EWART, Gas-Works, ANNAN, N.B.

NEW Station-Meter for Sale, capable of passing 30,000 cubic feet per hour, fitted with clock and tell-tale index, hydraulic valves, bye-pass, 14-in. connexions, in ornamental case, as per design, advertised by me in this JOURNAL.

Apply to GEORGE NEWTON, Union Street West, Oldham, or to the Directors of the Radcliffe Gas Company, near Bury, LANCASHIRE.

TO BE LET UPON LEASE, from the 25th day of March next, the GAS-WORKS at Herne Bay. The town is fast improving, and likely to become a very fashionable watering-place. This is an opportunity well worthy of the attention of Gas Makers. There is at present a good business attached to the works, which may be considerably increased.

For particulars apply to Mr. H. E. NEWTON, Secretary to the Company, at No. 66, Chancery Lane, LONDON.

The freehold to be disposed of if required.

Sealed tenders to be sent to the Secretary on or before the 7th day of March.

THE Directors of the Guildford Gaslight and Coke Company are prepared to receive TENDERS for the erection of a Cast-Iron TANK and GASHOLDER, with all necessary fittings, &c.

The Tank to be 73 ft. diameter, 16 ft. deep. The Gasholder 71½ ft. diameter, 16 ft. deep.

Plans and specifications can be inspected by applying to the Office, at the Gas-Works, or copies could be forwarded if required.

Tenders for the above to be sent in on or before Wednesday, Feb. 23, 1876, addressed to the Chairman of Directors, and endorsed "Tender for Tank and Gasholder."

The Directors do not necessarily accept the lowest tender.

JOSEPH SHAW, Manager.

Guildford Gas Office, Feb. 5, 1876.

BARNET DISTRICT GAS & WATER COMPANY.

NOTICE is hereby given that the ORDINARY HALF-YEARLY GENERAL MEETING of the PROPRIETORS of the above Company will be held at the London Tavern, Bishopsgate Street, in the City of London, on THURSDAY, the 24th day of February inst., at Two o'clock in the afternoon precisely, to receive the Report of the Directors and the Accounts for the half year ending the 31st day of December last, to declare a Dividend, to elect Directors and an Auditor, to fix the remuneration of the Directors and Auditors, and to transact the general business of the Company.

The Transfer Books will be closed from the 10th to the 24th inst., both inclusive.

By order of the Board.

ALFRED LABB, Secretary.

Offices, 60, Cornhill, London, Feb. 8, 1876.

TO PIPE FOUNDERS.

THE Gas Committee of the Sowerby Bridge Local Board of Health are prepared to receive TENDERS for the supply of the following cast-iron MAINS, viz.—

550 yards of 10-in.
310 yards of 8-in.
300 yards of 6-in.

with sundry special pipes.

Full particulars may be had on application to Mr. Saville, Engineer, Gas-Works.

Tenders to be sent in not later than Six o'clock on Thursday, Feb. 24, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Cast-Iron Mains."

By order,

CHARLES BARSTOW, Clerk to the Board.

N.B.—No allowance for tender, nor pledge to accept the lowest or any tender.

BOLTON CORPORATION.

GAS DEPARTMENT.

THE Gas Department are prepared to receive TENDERS for the supply of (Contract No. 1) Eight PURIFIERS, each 20 ft. square, with connexions and centre-valves complete.

Also (Contract No. 2) of a Travelling Crane.

Also (Contract No. 3) of a wrought-iron Annular Condenser.

Drawings and specifications may be seen at the Gas Offices, Bolton, on application to Mr. Harrison Veevers, C.E.

Sealed tenders to be delivered to me not later than Twelve o'clock at noon, on Wednesday, the 16th inst., endorsed "Tender for Gas Contract," and marked No. 1, 2, or 3, as the case may be.

The Committee do not bind themselves to accept the lowest or any tender.

By order,

R. G. HINNELL, Town-Clerk.

Town-Hall, Bolton, Feb. 3, 1876.

TO MANUFACTURING CHEMISTS AND OTHERS.

THE Directors of the Victoria (Newmarket) Gaslight and Coke Company, Limited, invite TENDERS for the whole of the AMMONIACAL LIQUOR produced at their works, for One or Two years, from the 1st day of March next, as may be agreed upon, and for the Ammoniacal Liquor at present in stock—namely, upwards of 20,000 gallons.

Particulars may be obtained on application to the undersigned, to whom tenders are to be addressed on or before the 28th of February inst.

The Directors do not bind themselves to accept any tender.

By order,

THOMAS WILKINSON, Manager and Secretary.

Newmarket, Suffolk.

OTTERY ST. MARY, DEVONSHIRE.

VALUABLE INVESTMENT, well worthy the attention of Gas Engineers and others retiring from active business. The important market town of Ottery St. Mary, which is situated in a beautiful and fertile valley on the eastern bank of the River Otter, from which it takes its name. There are several influential family residents, amongst others Lord Chief Justice Coleridge. There is a large lace mill, and a centre for the manufacture of Honiton lace.

The FREEHOLD GAS-WORKS of OTTERY ST. MARY for SALE, including the whole of the Buildings, Modern Plant, Mains, Meters, Service-Pipes, &c.

Price, particulars, and card to view the Works, can be had on application to THOMAS DAND, Gas, Water, and Consulting Engineer, Offices, Post-Office Chambers, Queen Street, Exeter, DEVONSHIRE.

AXMINSTER, DEVONSHIRE.

VALUABLE INVESTMENT, well worthy the attention of Gas Engineers and others retiring from active business. The important market town of Axminster, being beautifully situated; indeed, few towns richer than it is in objects of antiquity, in historical associations, and in lovely scenery—scenery varied in the most beautiful manner, with hills and dales, adorned with abundant timber, and watered by beautiful streams.

The FREEHOLD GAS-WORKS of AXMINSTER for SALE, including the whole of the Buildings, Modern Plant, Mains, Meters, Service-Pipes, &c.

Price, particulars, and card to view the Works, can be had on application to THOMAS DAND, Gas, Water, and Consulting Engineer, Offices, Post-Office Chambers, Queen Street, Exeter, DEVONSHIRE.

Now ready, Price 2s. 6d., Revised Edition.

THE TRANSFER OF GAS-WORKS TO LOCAL AUTHORITIES, from 1868 to 1875, with a Review of the LONDON GAS SUPPLY. By ARTHUR SILVERTHORNE, C.E.

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For GAS, WATER, and STEAM;

CAST-IRON PIPES, CORE BARS for IRONFOUNDERS,

STOCKS, DIES, and TAPS, GAS PLIERS and TONGS, &c., &c.,

ALWAYS KEPT IN STOCK.

LAP-WELDED IRON BOILER TUBES,

As supplied to the English, French, and Dutch Admiralties, and principal Railways and Engineers at Home and Abroad.

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GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

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2, KING EDWARD STREET,

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Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

TRADE MARK.

J. BEALE'S PATENT GAS EXHAUSTER.

BEALE'S CONTINUOUSLY ACTING

GAS EXHAUSTERS

ARE NOW MANUFACTURED BY

B. DONKIN & CO.

MR. J. BEALE, of East Greenwich, having retired from business, has made an arrangement with B. DONKIN & CO. for the sole manufacture of his Patent Solid-Slide Gas Exhausters.

B. D. & Co. also make Steam-Engines to drive Gas Exhausters direct or otherwise, and Gas-Valves.

Estimates and Prices on application to

B. DONKIN & CO.,

ENGINEERS & IRONFOUNDERS,

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LONDON, S.E.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

LEICESTER WATER-WORKS.

THE Directors of the Leicester Water-Works Company are prepared to receive TENDERS for the construction of a covered service RESERVOIR at Gilroes, near Leicester.

Drawings and specifications may be inspected, and forms of tender and schedule of quantities may be obtained, at the Offices of the Company, Bowling Green Street, Leicester, and at the Office of Messrs. Thomas and Charles Hawksley, Civil Engineers, 30, Great George Street, Westminster, S.W., on and after Monday, the 24th day of January inst., and tenders must be delivered at the Offices of the Company, at or before Ten o'clock in the forenoon of Saturday, the 19th day of February next.

The Directors do not pledge themselves to accept the lowest or any tender. By order,

J. H. WILLIAMS, Secretary to the Company.

Leicester, Jan. 17, 1876.

EXETER GASLIGHT AND COKE COMPANY.

THE Directors of the above Company invite TENDERS for the supply of from 5000 to 10,000 tons of North Country GAS-COALS (unscreened), such coal to be either of the following descriptions:—New Pelton, South Pelton, Holmside, Pelaw Main, or coal of equal quality, and to be shipped, f.o.b., at Newcastle or Sunderland during the present year.

The Contractor to state for which coal he tenders.

Sealed tenders, endorsed "Tender for Gas Coals," to be sent to me, the undersigned, on or before the 14th day of February next.

The Directors do not bind themselves to accept the lowest or any tender.

W. A. PADFIELD, Secretary.

TO TAR DISTILLERS, MANUFACTURERS, AND OTHERS.

THE Directors of the Phœnix Gaslight and Coke Company are prepared to receive TENDERS for the purchase of the TAR made at their respective stations, at Vauxhall, Bankside, and Greenwich, for the period of One, Two, or Three years from the 1st day of April ensuing.

The quantities will be approximately: Vauxhall, 1,000,000 gallons, Bankside, 280,000 gallons, and Greenwich, 360,000 gallons; in twelve months; total, 1,640,000 gallons. Tenders may be made for one or more of the stations.

Forms of tender, and conditions of contract, may be had upon application to the Secretary, 70, Bankside.

Tenders, endorsed "Tenders for Tar," to be delivered at this Office on or before Wednesday, the 1st of March, at One o'clock p.m.

The Board do not bind themselves to accept the highest or any tender.

By order of the Court of Directors,

I. A. CROOKENDEN, Secretary.

70, Bankside, S.E., Jan. 25, 1876.

THE Sheffield United Gaslight Company have for SALE the following Articles:—

The whole Manufacturing Plant, Gasholder, and Governor, of a small Gas-Work, capable of producing 10,000 cubic feet of gas per day. The gasholder is 27 ft. diameter by 14 ft. deep, cubic contents 8000 ft.

Connexions for ditto.

Four Purifiers, 12 ft. square, with 10-in. centre-valve and connexions.

Two Purifiers, 12 ft. square with 18-in centre-valve.

Two Jones's Exhausters, each to pass 25,000 cubic feet per hour, with valves and connexions, in good condition.

Two 7-in. Governors.

One Scrubber 8 ft. diameter, 18 ft. high, with 12-in. connexions and valves.

One Battery Condenser, 60 ft. long, 12 ft. high, and 2 ft. wide, with 14-in. connexions and valves.

Seven Lengths Hydraulic Main, 7 ft. long, 18 in. diameter.

Nine Lengths Hydraulic Main, 7 ft. long, 14 in. diameter.

Twenty-seven Dip-Pipes, 4 in. diameter.

Twenty-seven Bridge-Pipes, 4 in. diameter.

Full particulars as to quality and price can be obtained on applying to Mr. T. ROBERTS, the Manager, Commercial Street, SHEFFIELD.

TO GAS & WATER COMPANIES, & MUNICIPAL AUTHORITIES SUPPLYING WATER OR GAS.

CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875.

It is required, under a PENALTY OF FIVE POUNDS, that a PRINTED COPY of the 4th SECTION of the above Act shall be posted up at all Gas and Water Works in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of the section, in large type, on broad sheets, may be had of WILLIAM B. KING, 11, Bolt Court, Fleet Street, LONDON. Price, per post, 2s. per dozen, or 10s. 6d. per 100.

The Act came into operation on Sept. 1, 1875, and extends to Scotland and Ireland.

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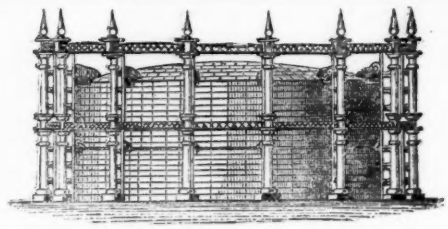

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Including Improved

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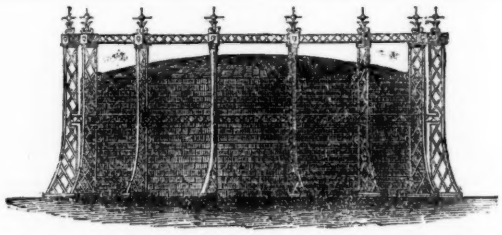

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AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

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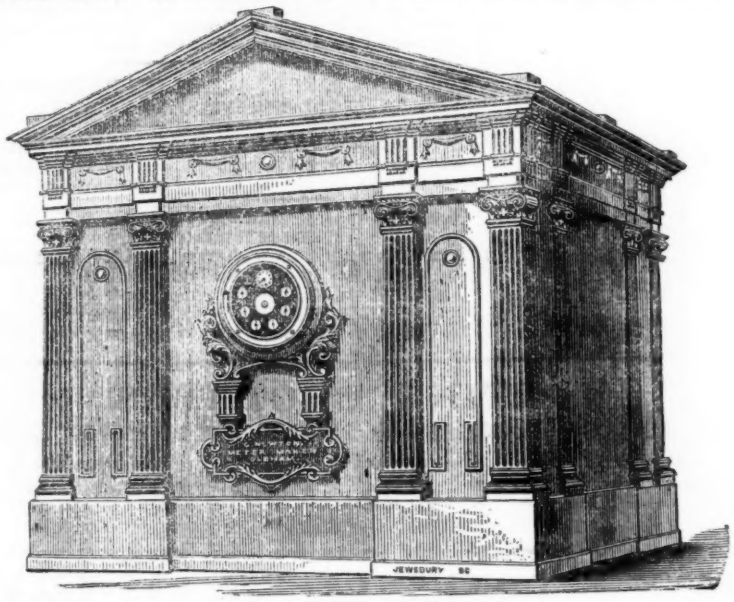

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GASHOLDER & GENERAL GAS APPARATUS MAKERS,

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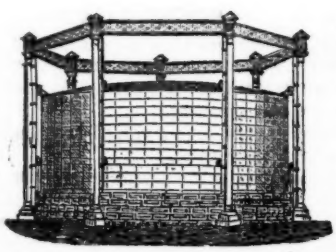

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Special attention is invited to their **"Improved Condenser,"** which is very effective, and much approved; also to their patterns of **Annular** and other **Condensers, Scrubbers**, and **Purifiers**, of all sizes, which they arrange either with **Centre** or Ordinary **Slide Valves.**

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IN THE MATTER OF

BRONNER'S GAS-BURNERS.

HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

D. M. NELSON,

48, GORDON STREET (late 135, BUCHANAN ST.),

GLASGOW,

Supplies every requisite in connexion with the distribution of Gas and Water.

Estimates and prices on application.

WOOD GRIDS for Purifiers and Scrubbers.

Cast-Iron PIPES and VALVES.

Street LAMP-PILLARS.

Patent Pipe SCREWING-MACHINES, &c.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

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Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

SZERELMEY Liquid Enamel, for Iron-work exposed to the atmosphere, supersedes paint, dries in two hours, absolutely prevents rust, contains no oil, requires no mixing, is ready for use, is laid on like paint, covers new or old iron or wood, old paint, tar, or whitewash, is waterproof, gives a fine polished surface, and costs scarcely one-fourth as much as paint—namely, one halfpenny per square yard. Samples to any address for 12 stamps. Particulars free on application.

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NONE of the Szerelmey compositions contain white or red lead, arsenic, or any other injurious ingredient. When in use and while drying they have a purifying effect on the atmosphere.

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SHIPPERS will receive liberal treatment at our hands. They will find that our Enamel Paste can be supplied for shipment at a price with which no ordinary paint can compete.

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MANUFACTURE AND DISTRIBUTION OF GAS. These sheets are the same as were laid before the Dublin Meeting of the British Association of Gas Managers; but in the REPRINT, NOTES have been added for the guidance of those using them. Copies of the two sheets may now be had, price 5s.
South Shields. W. J. WARNER.

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Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.
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By a simple process the Foul Lime is converted into Fuel, by the combustion of which the lime is reproduced as a purifying agent.
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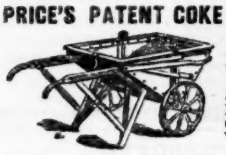

effecting a great saving of time, labour, and expense.
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For Repairing and Jointing Gas-Retorts, and preventing porosity,
Manufactured only by
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Particulars and Testimonials on application.

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For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
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Successors to
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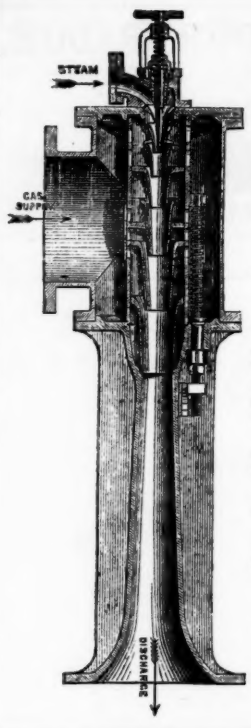

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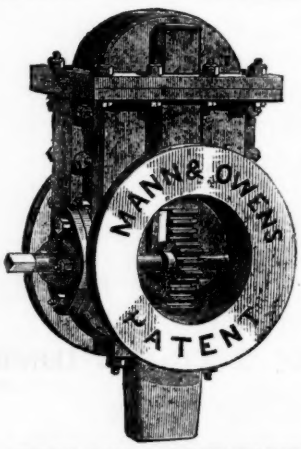
MANN & OWENS' PATENT GAS-VALVE.



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The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.
The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.
The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

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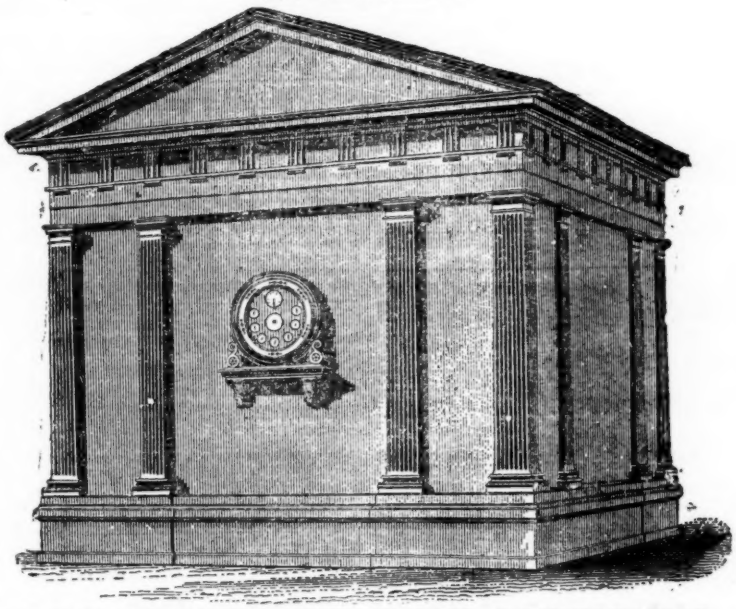

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GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.

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TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

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STEAM-ENGINES and EXHAUSTERS, separately or combined.

FOUR-WAY VALVES, one of which is equal to three ordinary Valves.

STATION GOVERNORS—the Gasholder cannot tilt and cause accident.

BREEZE AND TAR FUEL MACHINE.

A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress of the construction of Works, post free, 2s. 6d.

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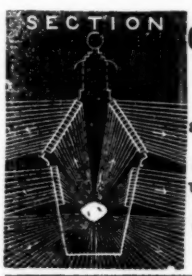

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Is now in use in Moorgate Street, Cheapside, and Trafalgar Square, and has been in successful operation upon Waterloo Bridge since Oct. 7, 1871.

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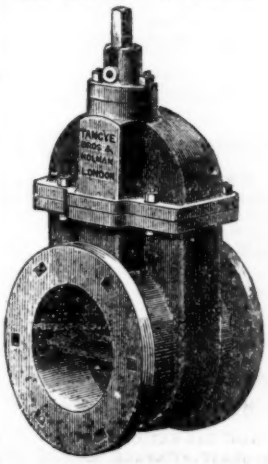

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Cubic Feet.	Illuminating Power.	Coke (sup. qual.).
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This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.
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Cubic feet of Gas yielded per ton . . .	10,050
Illuminating power in sperm candles . .	15·4
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Owner of the Works at which Fire-Clay Retorts were first made), can supply
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References can be given to managers of above a hundred Gas-Works whom he supplies.
He ships at Charlestown his
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FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
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DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for
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Proprietors of
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Manufacturers for Home and Export.
GAS-RETORTS, GLASS-HOUSE FURNACE,
BLAST-FURNACE, TANK BRICKS, LUMPS, TILES,
And Every Description of Best Fire-Bricks.

MESSRS. NEWTON, CHAMBERS, & CO.,
THORNCLIFFE IRON-WORKS AND COLLIERIES,
NEAR SHEFFIELD,
STRONGLY RECOMMEND A TRIAL OF THEIR
CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

GAS PURIFICATION & CHEMICAL Co., LIMITED,

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The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

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SILKSTONE COAL COMPANY, LIMITED,

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Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	10,775
Weight of coke in lbs. per ton of coal	1,465

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE LOCHORE AND CAPLEDRAE CANNEL COAL COMPANY, LIMITED.

Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: 19, MAITLAND STREET, EDINBURGH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.		Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	..	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	..	34·83
Value of 1 cubic foot of gas in grains of sperm	780	..	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	..	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	..	71 minutes.
Gravity of the gas (air = 1000)	596	..	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.		Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	..	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	..	33·09
Value of 1 cubic foot of gas in grains of sperm	878	..	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	..	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	..	67 minutes.
Gravity of the gas (air = 1000)	677	..	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

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